ENGINEERING AND
BOILER HOUSE REVIEW

ESTABLISHED 1899

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VOL. 75 NO. 11 • THE PIONEER STEAM JOURNAL • NOVEMBER, 1960

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RADIATOR VALVE
TYPES RA AND RAD
for hot-water and low-pressure steam heating systems is the only available means of obtaining a simple, automatic temperature control geared to the heat requirements of the room at any time.
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1 *Lockheed, with their 25 years' experience on precision hydraulics, serve you by planning the most effective equipment for your purpose.*

2 *With their sound practice, fine material and precision workmanship they serve again by ensuring dependability and durability.*

3 *Their third service is after sales—a team of Lockheed Engineers keeps your installation up to concert pitch, and if required attends at any time anywhere. All Lockheed systems carry one year's free service.*

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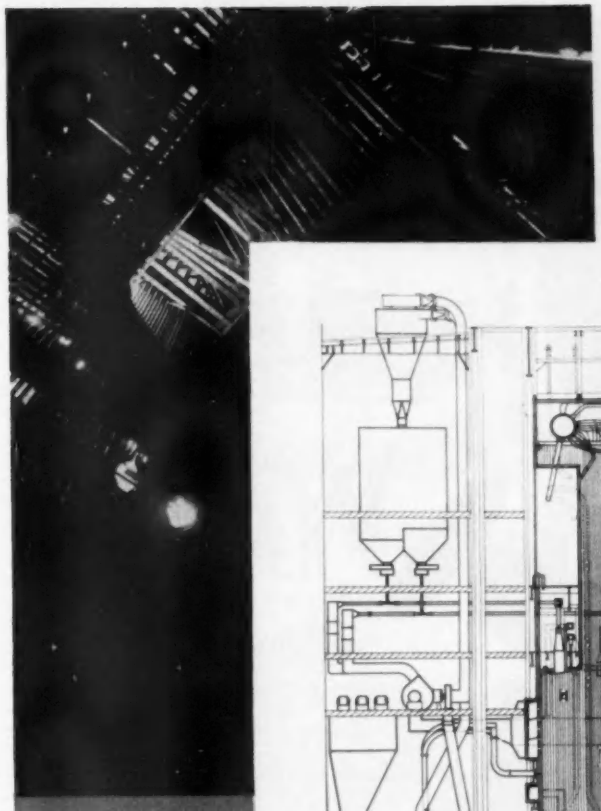

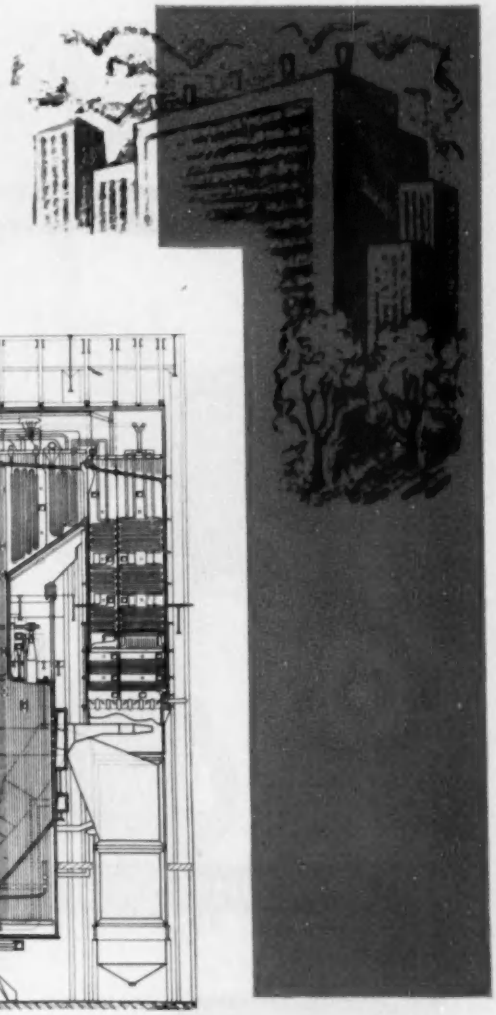

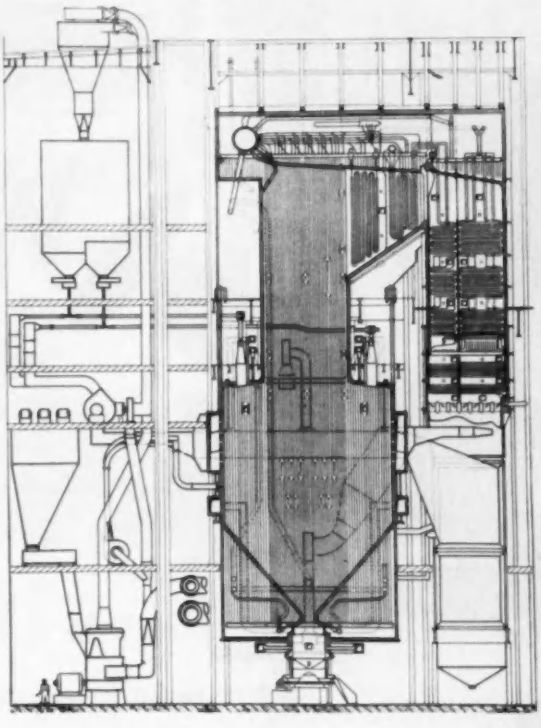

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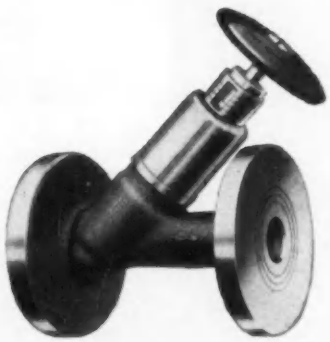

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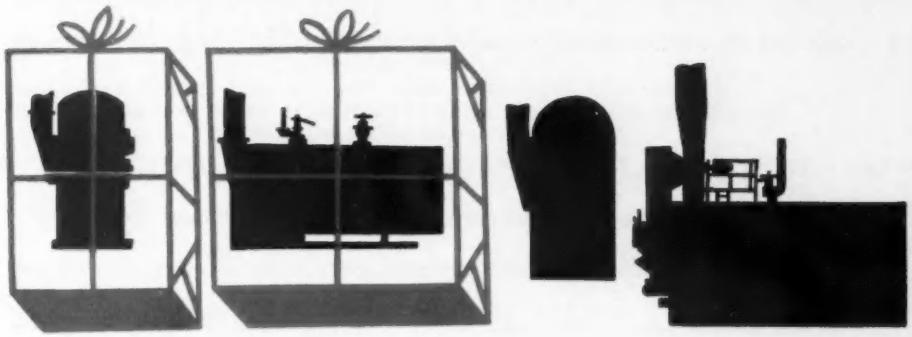

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TAS/CH.690

New deal for boiler users!

'Alfloc' Service Contract ensures against breakdowns caused by faulty feed-water

Boiler breakdowns and unscheduled repairs mean loss of production, loss of money, worry for everyone. Many of these can be laid at the door of faulty feed-water—but there's one way to ensure that they won't be. By taking out an 'Alfloc' Service Contract you unload your feed-water problems, at the stroke of a pen, on to experts with the whole of I.C.I.'s technical resources behind them. Regular checks, regular supervision, regular supply of the right chemicals banish scale, corrosion and carry-over and provide long-term confidence in boiler plant.

How the 'ALFLOC' SERVICE CONTRACT works

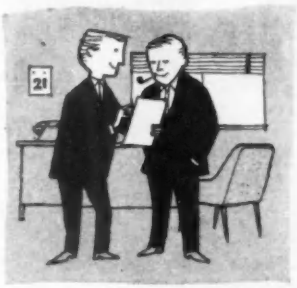
'Alfloc' sends a qualified, experienced water-treatment specialist to make a thorough analysis of your boiler plant feed-water and operating conditions.

Call in an 'Alfloc' specialist

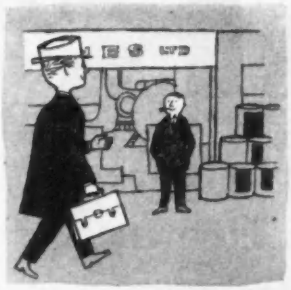
Waters vary so much in composition, behaviour and manner of use that there is no universal answer to your problems. To be certain our methods can produce a solution to your problems, we must know something about your feed-water and plant. This is why we want you to ask an 'Alfloc' specialist to visit you. Take the first step towards an 'Alfloc' Service Contract now—fill in the coupon opposite and post it to us.

The 'Alfloc' Water Treatment Service

The 'Alfloc' Service Contract was originally produced to provide the technical assistance so essential to the stationary boiler plant of small or medium capacity where the employment of specialist resident staff would be uneconomic. 'Alfloc' can also help on many problems arising from other uses of water—process and cooling water treatment, treatment of municipal supplies, locomotive feed-water treatment and treatment of ships' boilers. In such cases a Service Contract may not always be suggested as qualified staff may be available to give technical supervision, or the technical supervision required may be less.



On the basis of this visit the 'Alfloc' representative makes recommendations for feed-water treatment and draws up a Service Contract to suit your needs.



Under the Service Contract all the 'Alfloc' treatment chemicals you need are supplied for an annual fee; a qualified representative calls a stated number of times each year to carry out tests on your plant and advise your engineers; and, if necessary, a test kit and feeding equipment are supplied on loan.

In return, you undertake to make simple daily tests on the boiler-water, and to use the results to adjust treatment to meet changes in day-to-day conditions.

Please arrange for an 'Alfloc' specialist to call

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COMPANY_____

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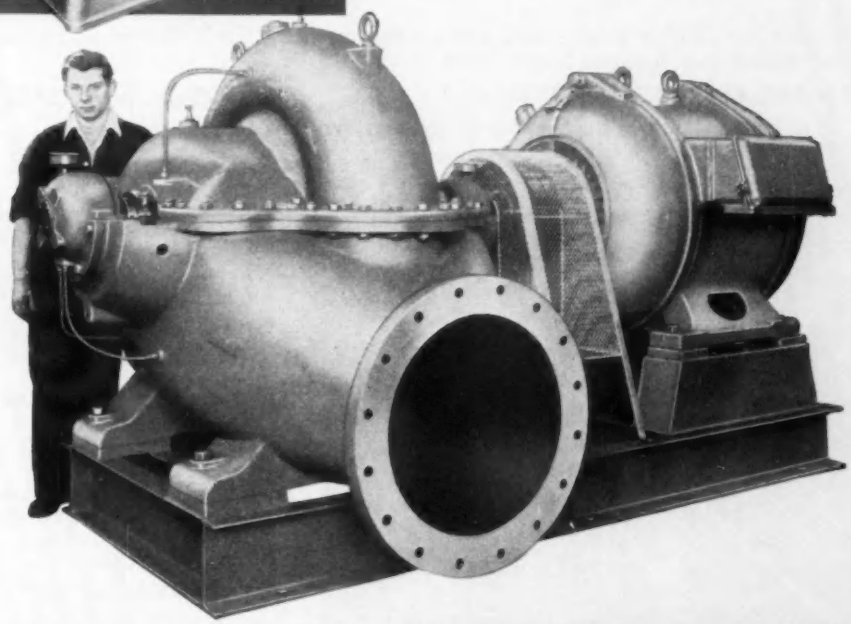
15 or 15,000 g.p.m.

(and more!)

WS features mean better service

Type 'L' pumps of split case construction provide easy access to the interior without disturbing pipe or shaft connections. Above all, Worthington-Simpson reliability means long and efficient service with the minimum attention and maintenance costs. This versatile range covers capacities from 15 to 15,000 g.p.m.; heads up to 660 feet.



TYPE 'L' SINGLE STAGE VOLUTE PUMPS

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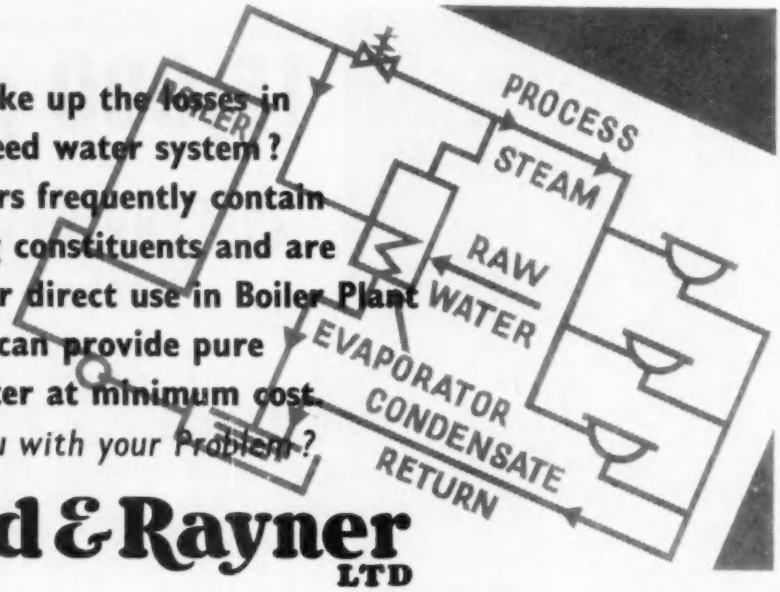
P.4218



How do you make up the losses in your boiler feed water system?
Untreated waters frequently contain scale-forming constituents and are unsuitable for direct use in Boiler Plant
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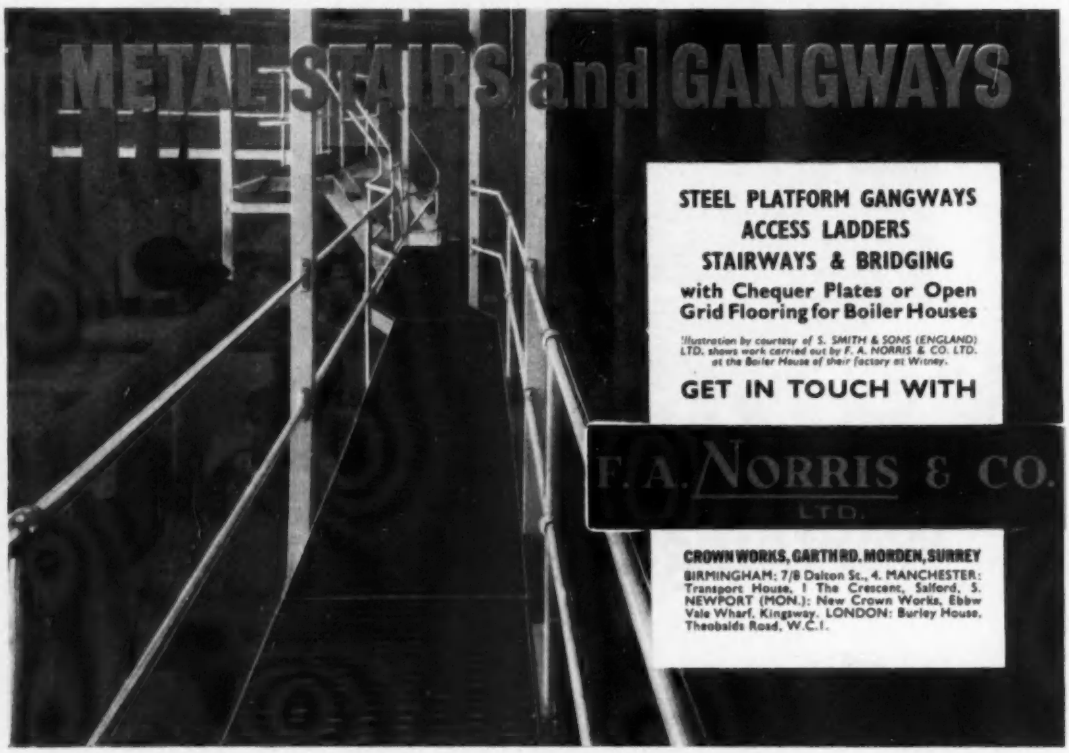
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ACCESS LADDERS
STAIRWAYS & BRIDGING
with Chequer Plates or Open Grid Flooring for Boiler Houses
Illustration by courtesy of S. SMITH & SONS (ENGLAND) LTD. shows work carried out by F. A. NORRIS & CO. LTD. at the Boiler House of their factory at Witney.
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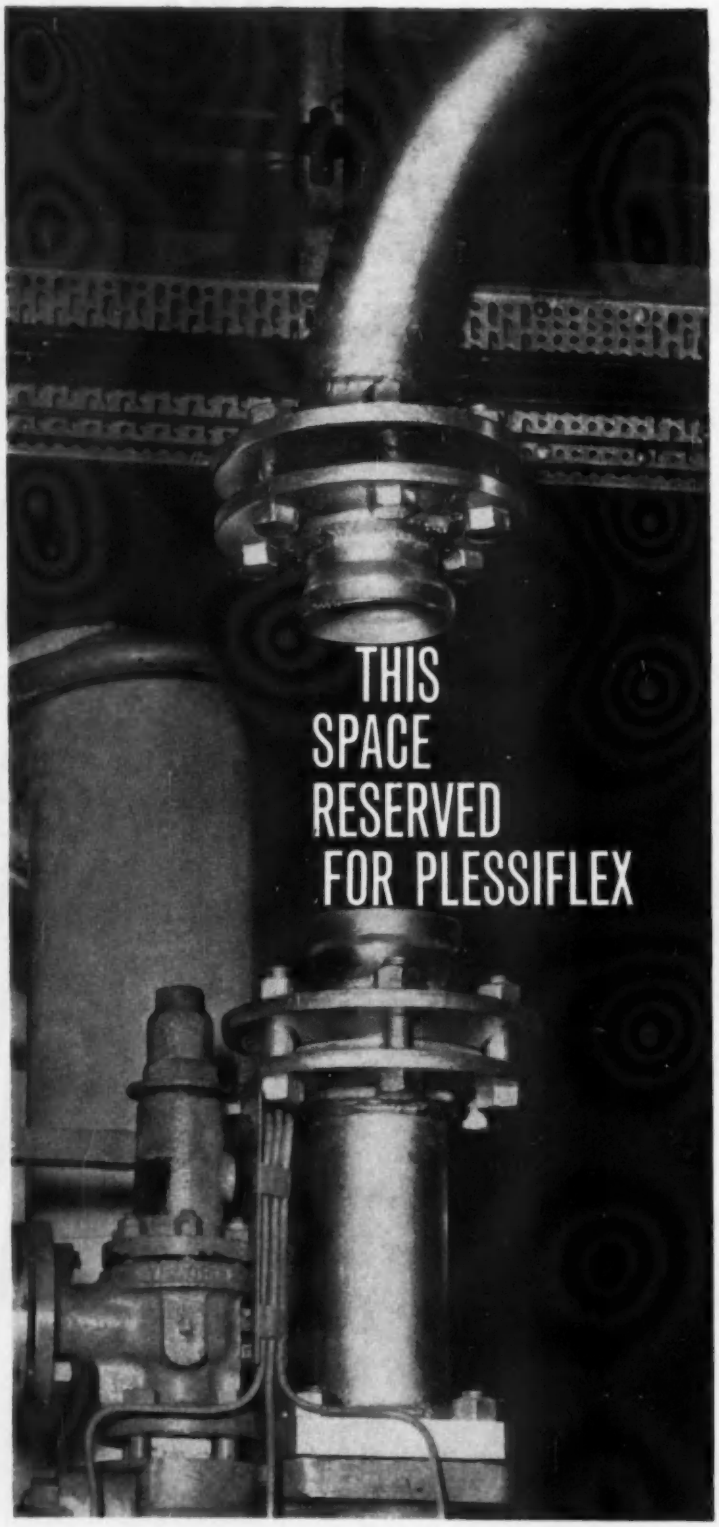

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checks itself!

New Honeywell Protectorelay brings electronic 'Mastermind' control to both *gas and oil* burning installations... adds component check to basic flame safeguard functions

Component check means added safety. Before power supply is resumed to a shutdown burner, Honeywell's Protectorelay checks the control system for flame simulating faults. If these are present, it prevents burner operation.
Electronic speed, electronic sensitivity ensure that flame failure is sensed immediately it occurs.
A temperature compensated safety switch shuts down the burner following a trial ignition period.
Honeywell design, Honeywell ease of installation extends electronic safety control to oil or gas fired boilers and furnaces. The Protectorelay will tolerate up to 300 ft of *unscreened* lead with a photocell and up to 100 ft with a flame rod.

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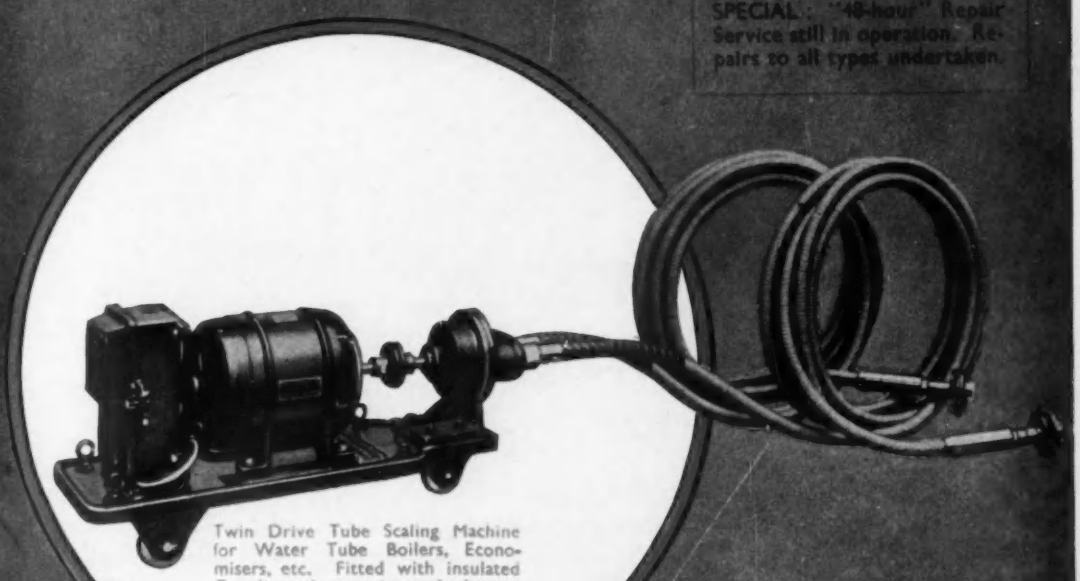

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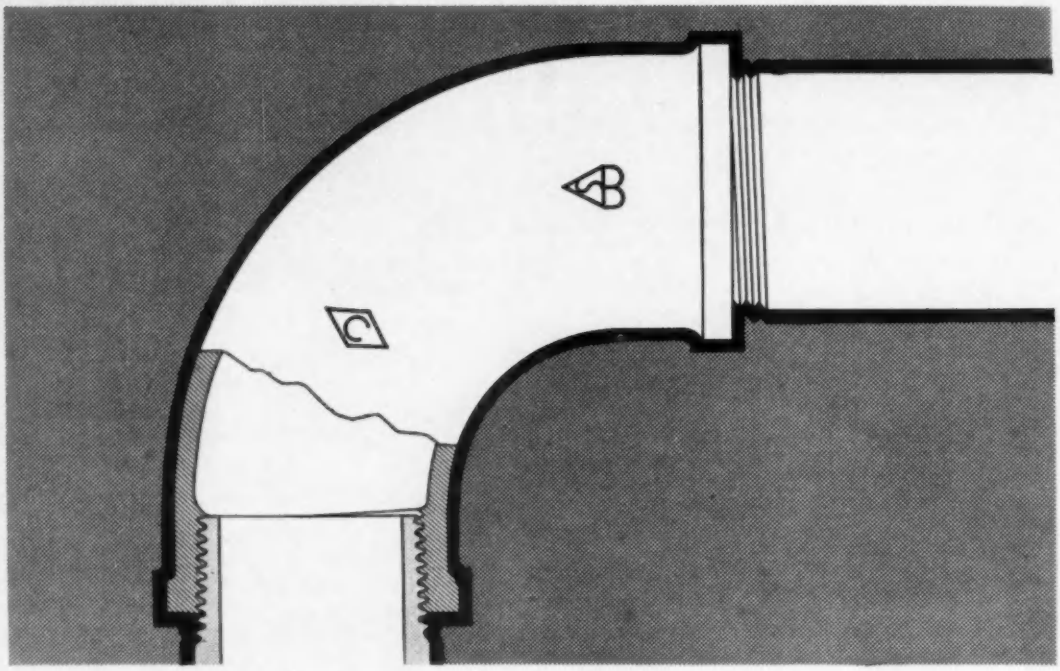

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A full versatile range. Crane Pipe Fittings, both plain and banded patterns, are made in many types; they range in size from $\frac{1}{8}$-inch to 6-inches, equal and reducing. If you would like full details, please write to us at the address below.

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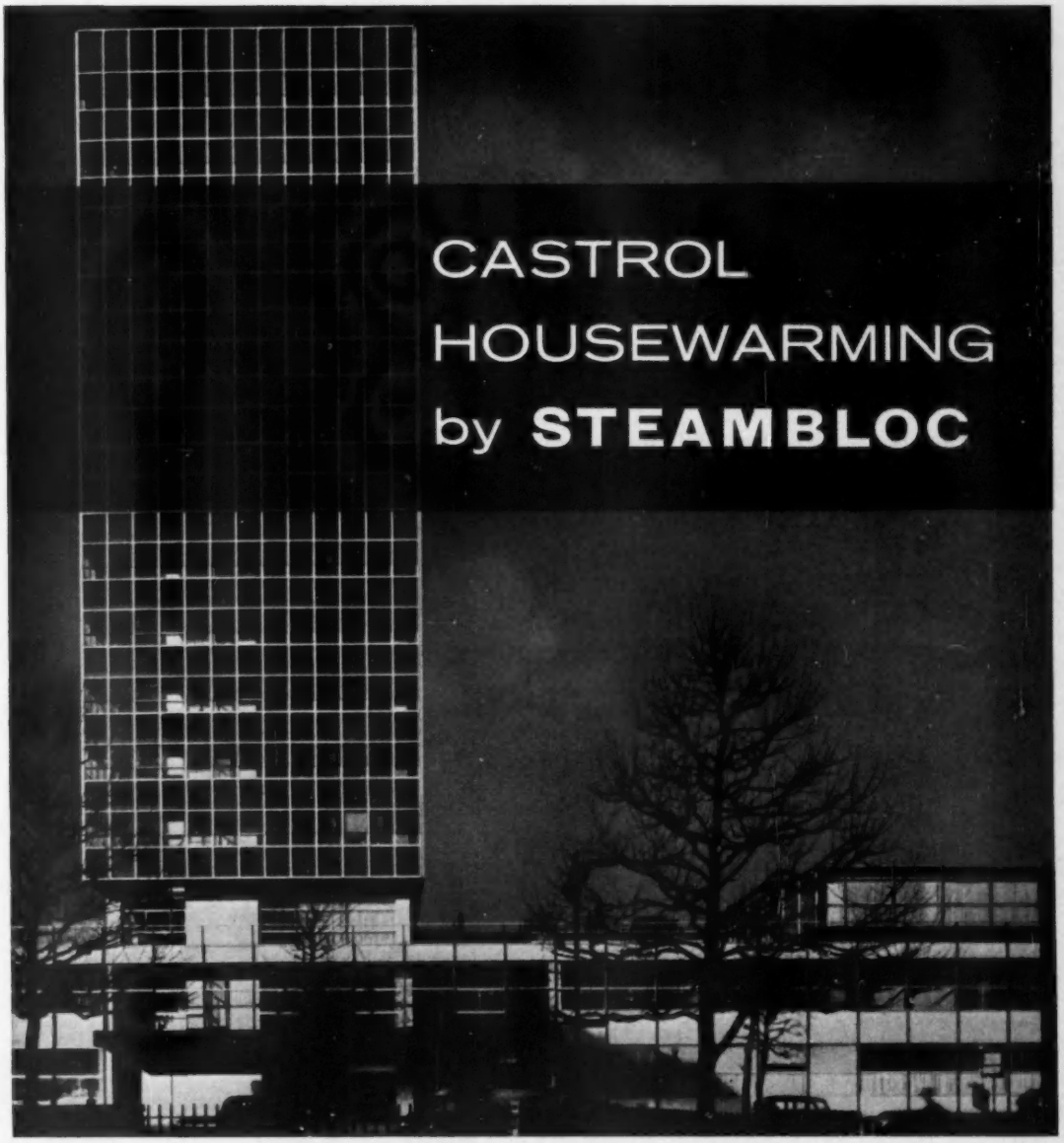

ABOVE: *Castrol House, impressive new headquarters of Castrol Limited. Architects—Gollins, Melvin, Ward & Partners* BELOW: *The three Steambloc boilers that provide heating services.*

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STEAMBLOC—the fully automatic packaged boiler—is compact and labour saving. It needs no additional equipment.

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SBC15a

3 GOOD REASONS

for specifying the Spanner Mark III Boiler

Only three good reasons ?

Well, there are a great many, really, but we've only got a page. so let's start with three.

First, this is the Spanner 1960 Boiler—designed not just for to-day —but the decade ahead—and beyond.

Second, this latest triumph of Spanner Boilers embodies the same specialist skill and experience which have been proved in hundreds of Spanner installations throughout the world.

Third, the Spanner 1960 Boiler is equally economical for heating and processing loads, modulating the output automatically according to steam demands.

SPECIAL FEATURES

- Goes into confined spaces.
- Fast steam raising.
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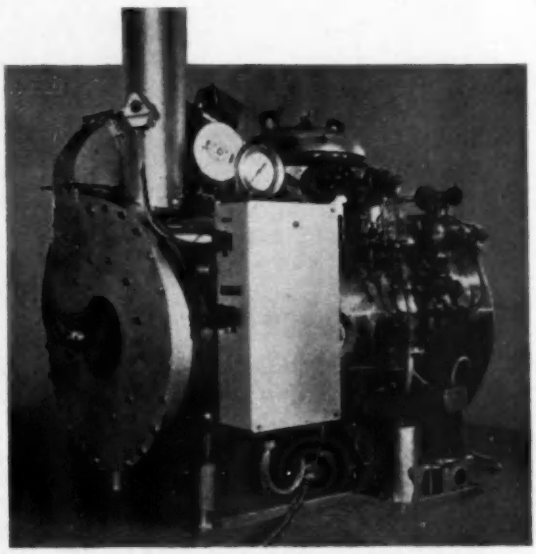
- Fully automatic.
- Easy to install and maintain.
- Steam outputs from 1,000 to 8,000 lb/hr.

Send for full details of this outstanding new Spanner boiler.



Swirlyflo Tubes

SPANNER BOILERS LTD.

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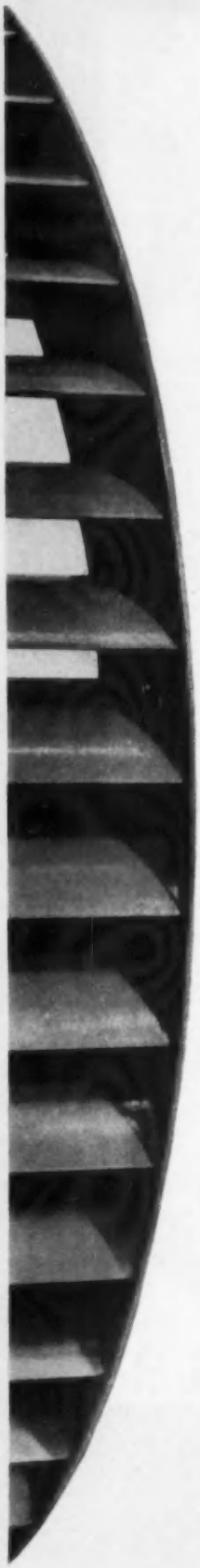
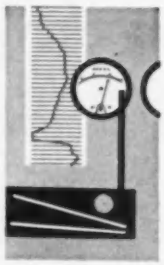


formula for leadership

Experience Founded originally in 1823 the Company has had the widest experience in the design and manufacture of all types of equipment for the handling of air and other gases. Blowers, exhausters, heaters, filters, dust and fume removal equipment, and of course, fans of all types, fall within this wide scope. Fans of every size and for every purpose, from Coal Mines to Aircraft Carriers, have been designed, manufactured and tested by Keith Blackman and installed in all parts of the world—experience unparalleled in the field.



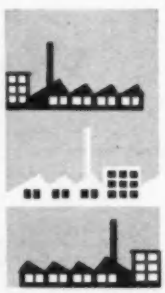
Research Keith Blackman's lead in design is maintained by five separate research departments. Specialised facilities are available at Tottenham for the development and testing of axial fans, centrifugal fans and filtration equipment, while a metallurgical laboratory controls the quality of materials founded at Arbroath. Tottenham also possesses one of the most advanced acoustics laboratories in the world for the investigation of sound levels in all types of fan engineering equipment.

In addition, the company's generating station, as well as supplying power to the factory, is designed to produce a wide range of A.C. and D.C. supplies for the test beds.

Range The Keith Blackman range covers virtually every type of fan and blower in all sizes—axial types from 5 inch to 100 inch diameter, centrifugal types ranging from 1¼ inch to 180 inch, and propeller fans from 6 inch to 72 inch diameter. Much equipment is designed for clients' specific requirements involving, frequently, the use of special materials including pvc. Other equipment is made for heating, cooling, washing, dust and fume extraction, filtration and air conditioning. *Five thousand fans of varying types are kept continuously in stock for quick delivery.*

Keith Blackman Ltd
(incorporating Blackman Export Co. Ltd.)
MILL MEAD ROAD, LONDON N.17 TOTTENHAM 4522

Leaders in the Fan Industry



Resources The company's three factories cover an area of 17¼ acres, and employ over 1,800 people. The main Tottenham works produces small and medium units and includes drawing offices, test facilities and machine shops, as well as the sales and administration offices.

The Arbroath works deals with the production of the larger fans. Its iron and non-ferrous foundry plant supplies the whole of the company's casting needs.

The Edmonton Factory concentrates on light sheet metal and plate work and the fabrication of steel structures.

Virtually all components, including fan motors and bearing housings, are thus designed and manufactured within the organisation—a unique combination of resources.

Service Through the years the company has built up an enviable reputation for service at all stages. Sales representatives are all fully trained technical men capable of giving 'on the spot' advice on routine applications or special problems. The sales organisation operates from branches throughout the country backed by a staff of qualified sales engineers at Head Office.

Despatch of stock items, of which 5,000 units are kept continuously available, is possible in as little as four days. The Company has its own road transport fleet and direct rail connections from the main factory.

TA1545/1040

THREE WATER TUBE PACKAGE BOILERS FOR THE PETROLEUM INDUSTRY

To provide steam for process work, for steam tracing the oil pipelines, and for domestic heating, 3 type 65.S. water tube packaged boilers for outdoor installation have been supplied to the Whitegate Oil Refinery. These are the first water tube packaged boilers to be used in Eire. Being completely built in Wolverhampton the boilers only had to be connected up on site. Each boiler has an evaporation of 32,000 lb/hr and is fitted with an economiser and superheater from which the final steam temperature is 450°F working pressure 150 p.s.i. The boilers are designed for oil or gas firing. Further details about these packaged boilers will be supplied on request.

JOHN THOMPSON GROUP

JOHN THOMPSON
WATER TUBE BOILERS LIMITED
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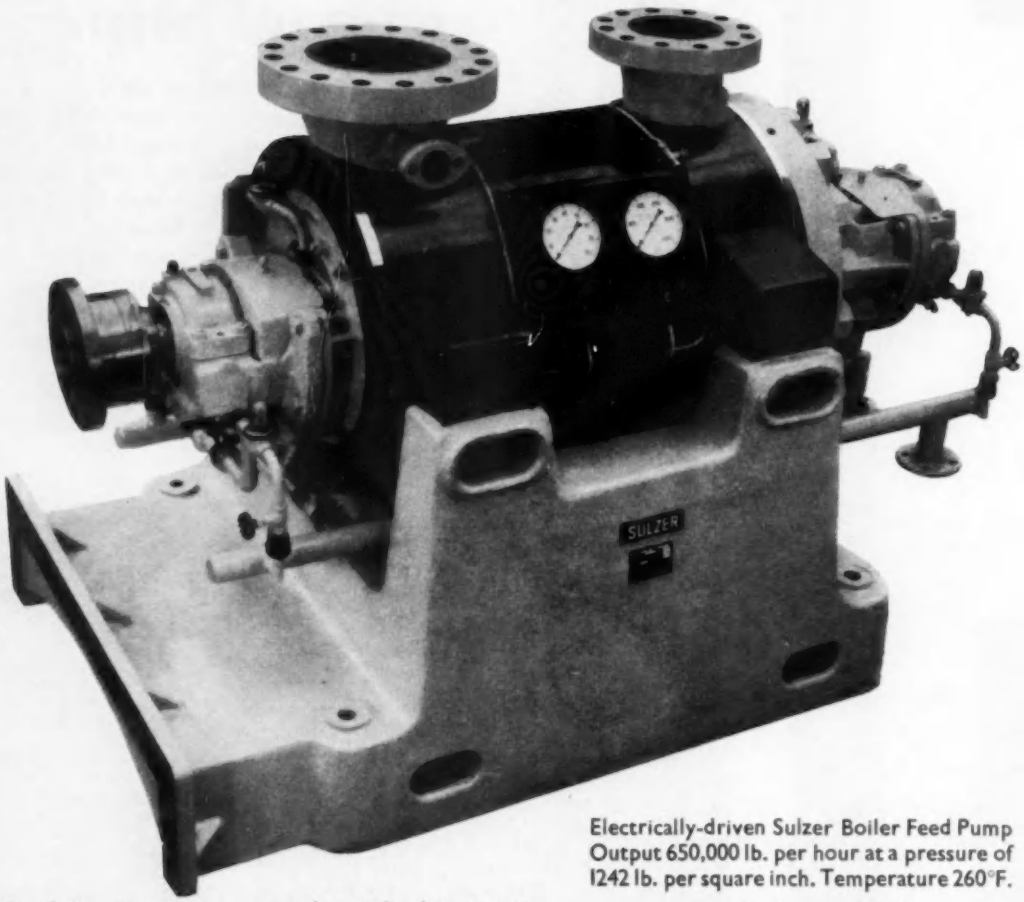
SULZER
BOILER - FEED PUMPS



Electrically-driven Sulzer Boiler Feed Pump
Output 650,000 lb. per hour at a pressure of
1242 lb. per square inch. Temperature 260°F.

Six Sulzer low temperature electrically-driven units each rated for an output of 650,000 lb./hr. have been supplied for the **CHAPELCROSS** installation of the

UNITED KINGDOM ATOMIC ENERGY AUTHORITY

one of nine units for
MARCHWOOD POWER STATION
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CENTRAL ELECTRICITY GENERATING BOARD

Complete range of Boiler Feed Pumps for nuclear and orthodox thermal plants including advanced class units.

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(INCORPORATING HATHORN, DAVEY & COMPANY, LTD.)

SULZER BROTHERS LIMITED HAVE OFFICES AT — WINTERTHUR - PARIS - NEW YORK - MADRID - CAIRO - RIO DE JANEIRO - BUENOS AIRES - KOBE - LISBON - JOHANNESBURG - MEXICO CITY
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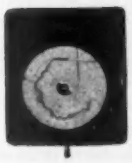
Instrumentation in the boiler house

ensures correct conditions and fuel economy



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Indicating and recording gauges.

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Indicating and recording gauges.

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Manufacturers of instruments for the indication, recording, controlling of : Temperature, pressure, liquid level, volume, specific gravity, humidity, etc.

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Subsidiaries or Agents in most countries.

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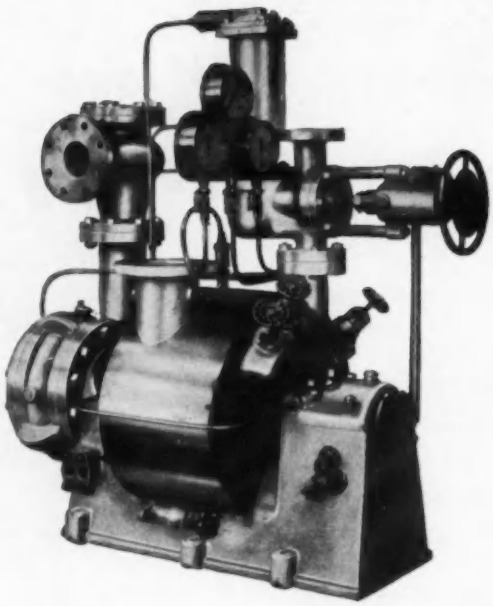
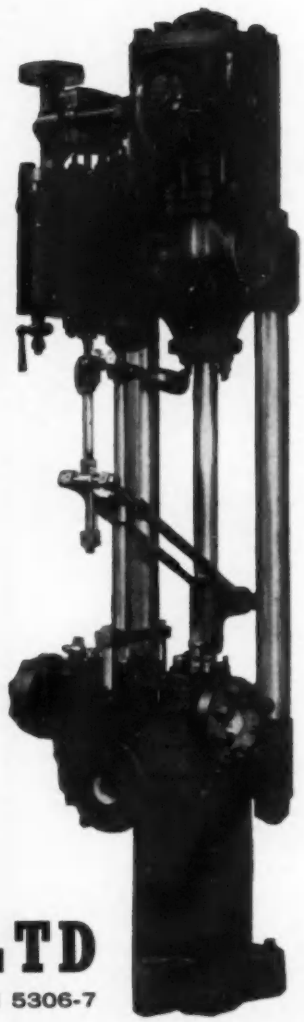
HALL

BOILER FEED PUMPS for strenuous duties





The Hall range of Boiler Feed Pumps includes Direct Acting Reciprocating Pumps of extremely robust construction in capacities from 100 to 10,000 gallons per hour. Also ranges of Turbo Feed Pumps for 4,000 to 37,000 gallons per hour capacities.
These pumps are the products of over 50 years' experience in specialising in Boiler Feed Pump manufacture, concentrating on reliability, efficiency and accessibility.

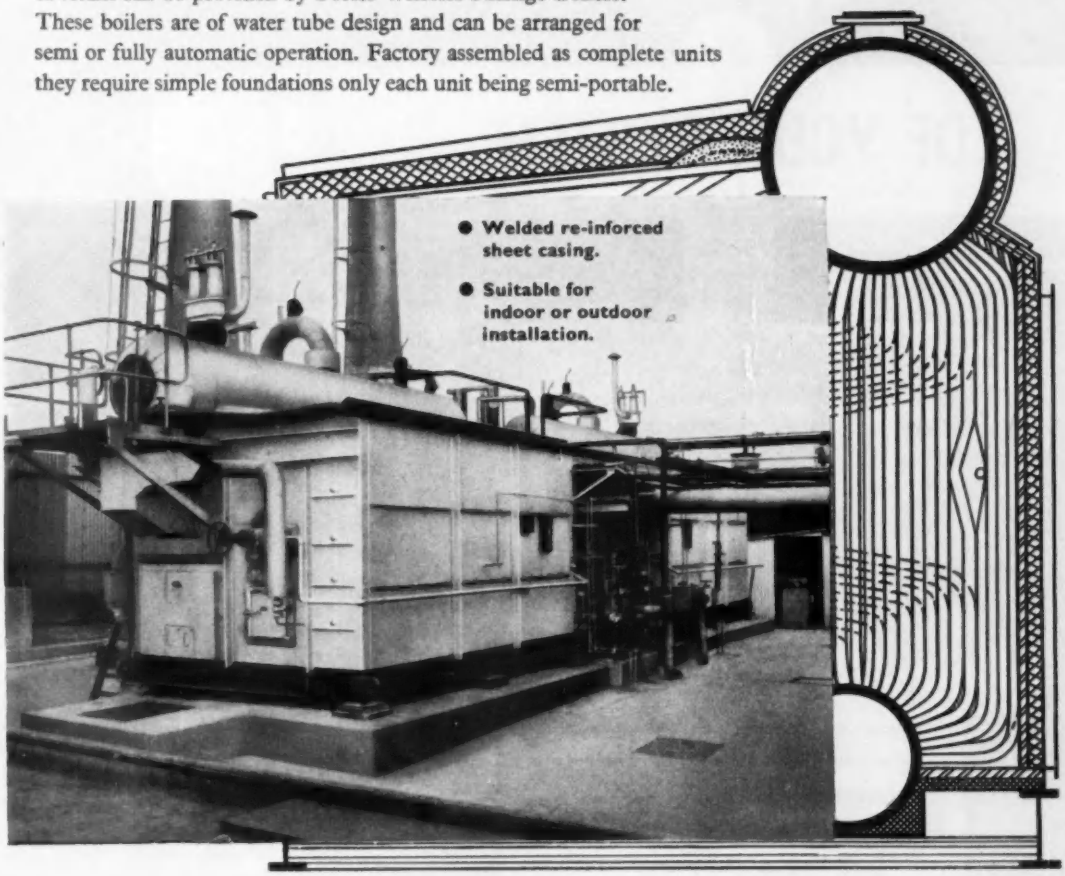
accessible for easy maintenance

J. P. HALL & SONS LTD
PETERBOROUGH TEL: PETERBOROUGH 5306-7

P4186

10,000 - 60,000 lb/hr

of steam can be provided by Foster Wheeler Package Boilers. These boilers are of water tube design and can be arranged for semi or fully automatic operation. Factory assembled as complete units they require simple foundations only each unit being semi-portable.



The illustration shows a typical installation of three Foster Wheeler Packaged Boilers installed for the Esso Petroleum Company at Trafford Park, Manchester. Each Boiler providing steam at 14,000 lb/hr with a steam pressure of 200 p.s.i.g. at 450°F.

Units are being operated to provide steam pressures to 1,200 p.s.i. and final steam temperatures to 865°F. Drum internals can be fitted to permit a steam purity guarantee of 1 p.p.m. solid carry-over when boiler water is maintained within approved concentrations. Superheaters can be provided which are of the fully drainable type and easily withdrawn for maintenance purposes.

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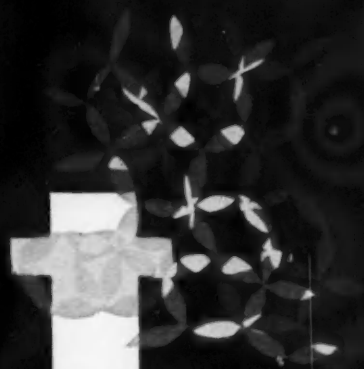
OF YOUR SYSTEM



These are some of the slime-forming organisms which cause loss of efficiency and blockages in industrial cooling water systems by fouling heat-transfer surfaces, filters, pipes, storage basins and cooling towers. Organic growths can be controlled by chlorination, a simple method which increases efficiency and reduces to a minimum the interruption of plant operation. For advice on the application and handling of liquid chlorine and hypochlorites, consult:

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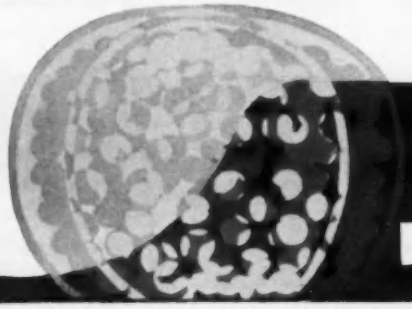


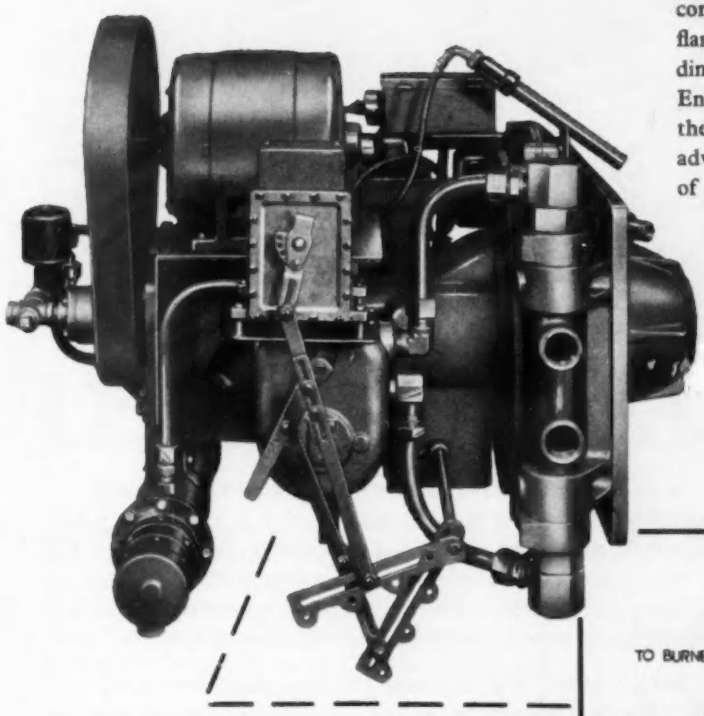
CH.84

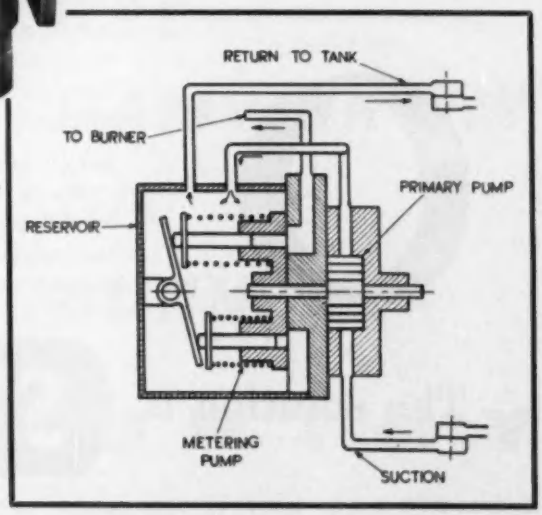
ANNOUNCING THE

SWINNEY ENTERPRISE

Automatic Rotary Oil Burner

Swinney-Enterprise Rotary Oil Burners are now available in a range of 12 sizes having outputs from 3.5 gallons per hour to 166 gallons per hour and are suitable for use with the heaviest grades of fuel. Burners are available for operation on natural, induced or forced draught and with a wide variety of control systems. By correct choice of combustion head, flame shape can be altered to suit the dimensions of the combustion chamber. Entirely manufactured in the U.K. the Swinney-Enterprise is the most advanced oil burner for firing all types of steam and hot water boilers.





The Measured Rate Metering Pump is exclusive to Swinney-Enterprise burners. Regardless of grade, viscosity or temperature of fuel the metering pump will provide the correct flow of fuel to ensure precise air/oil ratio and efficient combustion.

FOR FURTHER INFORMATION WRITE OR PHONE:—

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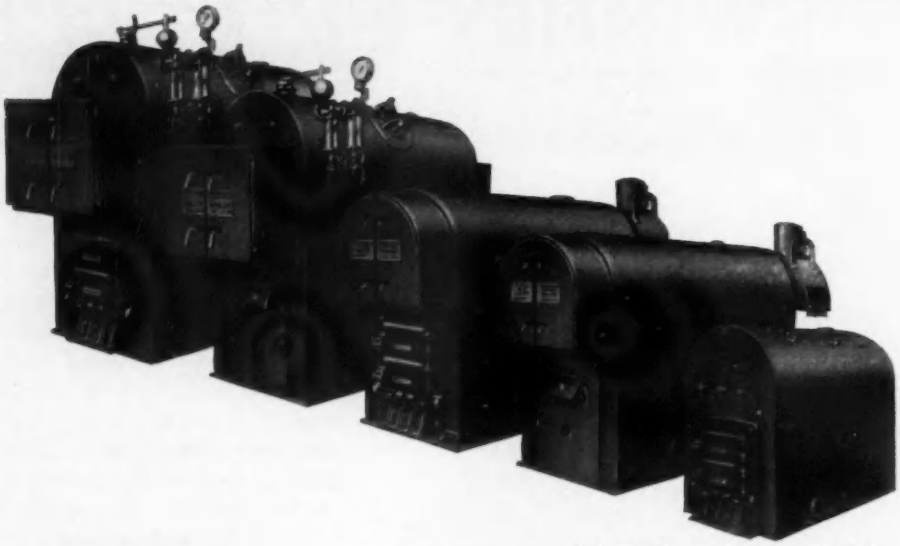

Boilers by Hartley & Sugden Ltd., Halifax

A section of copper piping showing heavy scale deposit

The same section after treatment with Starit

A Problem of Scale?

Is there a falling-off in steam raising? Do you suspect metal stress, or serious loss of heat during transfer from fuel to water? These and kindred questions in connection with boilers and feed pipes can be an indication of scale deposit that lowers the efficiency so vital to economical steam raising.

Starit effectively removes most types of scale from boilers and feed pipes, attacking and dissolving the scale to leave the metal in a first-class condition of conductivity. The action of Starit ensures rapid removal of scale deposit, but its effect on boiler plates is inhibited. Starit solution is especially effective for cleaning awkward corners impossible to reach by hand.

Starit is successful in most cases of scale deposit, but as some scale is immune to chemical treatment, send us a sample. We will then determine the suitability of Starit for your particular problem and send you a booklet dealing with the uses of Starit and methods of its application.

The solution is STARIT

TRADE STARIT MARK

STARIT LIMITED DARWEN · LANCS

LEADERS IN ALL FIELDS..

For efficiency and reliability the Hamworthy Rotary Oil Burner just cannot be beaten. And, if you are interested in complete boilerhouse automation and need a truly automatic burner, remember that the Hamworthy burner is the only burner which burns with unaltered efficiency regardless of changes in oil pressure and viscosity.
You cannot do better than to call in Hamworthy for a consultation at an early stage—they have the experience of oil-burning in your field.

USE HAMWORTHY OIL BURNERS

HAMWORTHY

the oil-firing specialists

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TAS/HY14

Coal sews things up

EMANCIPATION—for women—began just over 100 years ago, when Isaac Merritt Singer invented the first practical sewing machine and released women from one of the oldest domestic chores in history—stitching and sewing by hand. With the turn of a wheel, busy mechanical fingers worked faster, better—and tirelessly. Today, every Singer sewing machine is a compact miracle of sewing skills—but its basic duty remains essentially the same, to the delight of millions of women in every land.

At the vast Singer factory at Clydebank in Scotland, chain grate stokers feed a moving belt

for Singer

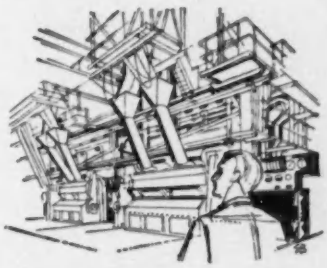
of heat under the 4 giant boilers in the impressive powerhouse. The fuel is coal—chosen by the directors for reasons of convenience, economy and reliability. The choice is a wise one, for coal, mechanically stoked, is smokeless, and produces more heat for the money than any other fuel. Furthermore, the coalfields of Britain can supply all the fuel our industries will need for scores of years to come.

Whether your own industry is big or small—remember Singer. Coal sewed up their fuel problems: the pattern is one you could copy with profit.

PROGRESSIVE INDUSTRY IS GOING FORWARD ON

COAL

ISSUED BY
THE NATIONAL COAL BOARD



Coal generates power at Singer's Clydebank Factory

Mr. C. H. Fielding, Power Station Superintendent, comments:

"At Singer we provide our own power and steam process requirements from coal.

Two large boilers were installed in 1928 and a further two in 1950. Each has a continuous rating of 60,000 lbs. per hour.

The factory also has a large woodworking department, and the considerable quantities of wood chips and sawdust which have to be disposed of are burned in the boiler furnaces along with coal. Coal and ash handling presents no problem here. The boiler fans and the sawdust control equipment are driven by variable speed motors. Control is simple.

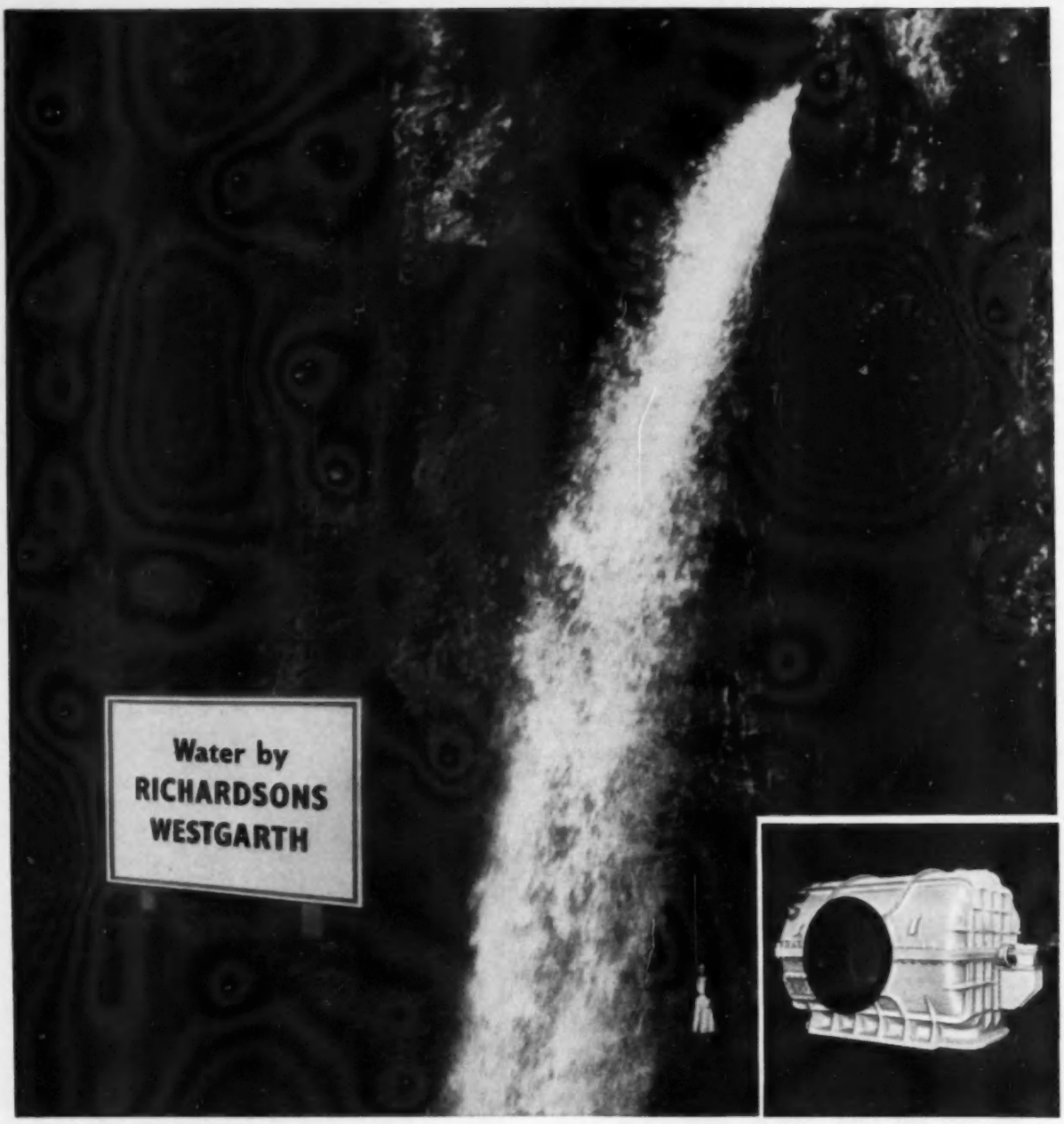
The designed efficiency of the boilers and economisers is 84% and they are operated between one annual overhaul and the next with nothing more than the normal maintenance. Their availability is high.

The quality of coal received is always consistent, its properties being regularly checked in the laboratory. Around 48,000 tons of coal and 4,000 tons of wood chips and sawdust are now consumed each year in the boilers.

We at Singer choose coal because it meets all our fuel requirements."

Here are some key facts and figures about the consumption of coal at Singer:

Number of boilers:	4 water tube
Method of firing:	chain grate stokers
Steam Pressure:	360 lbs. per square inch
Continuous max. rating:	60,000 lbs. of steam per hour each
Steam temperature:	725°F.
Feed temperature:	185°F.
Annual fuel consumption:	48,000 tons of coal



A single strainer of the type we supply to the C.E.G.B. handles five million gallons of water an hour... enough to maintain quite a spectacular waterfall. At Aberthaw Power Station there are six such units with a total capacity of 30,000,000 g.p.h. straining the condenser cooling water.

Richardsons Westgarth rotary strainers are made in a range of sizes from 160,000 g.p.h. to 5,000,000 g.p.h., they are self cleaning, operate continuously, and the accumulated sludge is blown out at intervals without interrupting the flow. *Please write for illustrated brochure.*

R W G

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RW 59

Whatever your tube maintenance problems AIRETOOL equipment will solve them FASTER... EASIER... AT LESS COST

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CANADIAN PLANT
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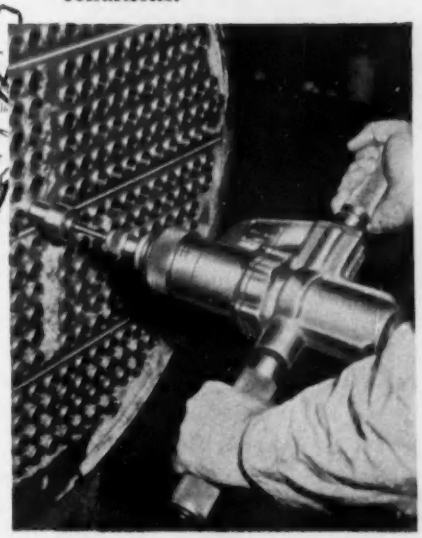
AIRETOOL stands up under torture

Yes sir! You can depend on Airetool for speed, accuracy and economy in tube maintenance

Airetool pneumatic tools—cleaners, drills, brushes and motors—are designed to meet the specific needs of refiners for efficient, low-cost tube maintenance and to do the job under the most difficult conditions.



For example, the AIRETROL Tube Expansion Control, illustrated at right, rolls up to 12 tubes a minute within .001 inch accuracy; maintenance costs drop and expensive tube failures are reduced. Labor costs are cut, too, because Airetrol's rugged, lightweight construction makes one-man operation easy.

And, one man can remove the hardest deposits and clean completely plugged tubes with Airetool's CC-475 Condenser Cleaner. The built-in flushing system keeps the drill cool and the cuttings washed away.

CC-475 CLEANER

If you're plagued by high tube maintenance costs, investigate the economies of Airetool tube equipment; it puts you on stream sooner and keeps you there longer. For full information write to:

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MANUFACTURING COMPANY
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More than 30 years' experience in pneumatic tools

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"CL'AIR"

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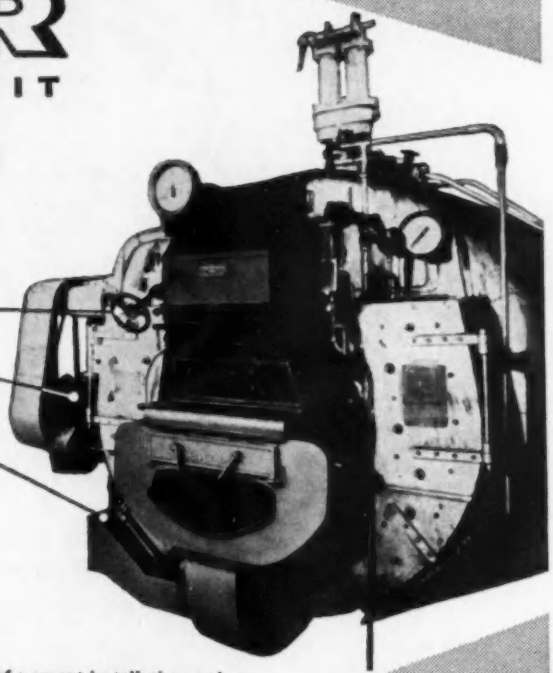
Patent Applied For

FLEXIBLE

Control of fire thickness
Control of Grate Speed
Control of Forced Draught



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Low maintenance costs. No Stoker working parts. High Efficiency Self Cleaning Grates. Designed for Low Grade fuels.

Part of a recent installation at the St. Lawrence Hospital, Chepstow.

(Photograph by courtesy of the Hospital Authorities)

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Smokeless combustion
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Full boiler rating.

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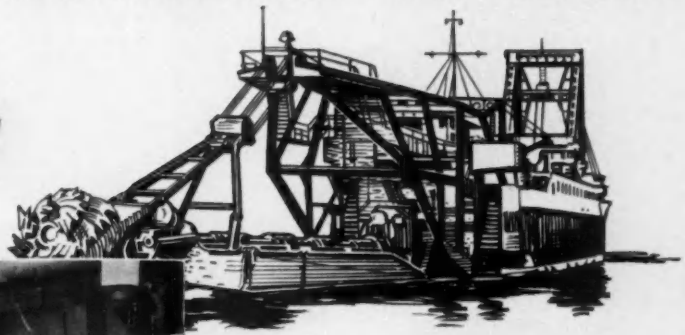

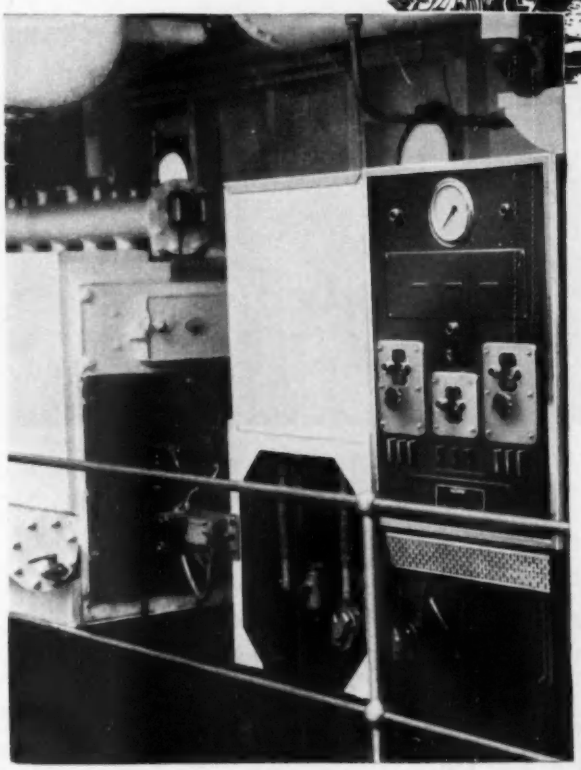

Europe's most powerful rock cutting dredger "Port Sunlight," is the first ship to be fitted with a medium pressure hot-water system, utilising waste heat from the engines. Pressure is maintained automatically on the heating system by a WARMAC C.1 PACKAGED pressure unit. The heat is required for the heavy oil storage and through heat exchangers for the low pressure heating to the accommodation. WARMAC are first in the field with their packaged units—write now for full technical information quoting ref: EBR/27.

A close up view of the compact WARMAC medium pressure unit on "Port Sunlight". Supplied to Crittall Marine Ltd.

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Photograph by courtesy of Davey, Paxman & Co. Ltd.

Changing conditions in Industry today call for new materials and new techniques in the field of insulation.

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The photograph shows the insulation of five Davey, Paxman Ultranomic boilers at the Bristol Aeroplane Co. Ltd.

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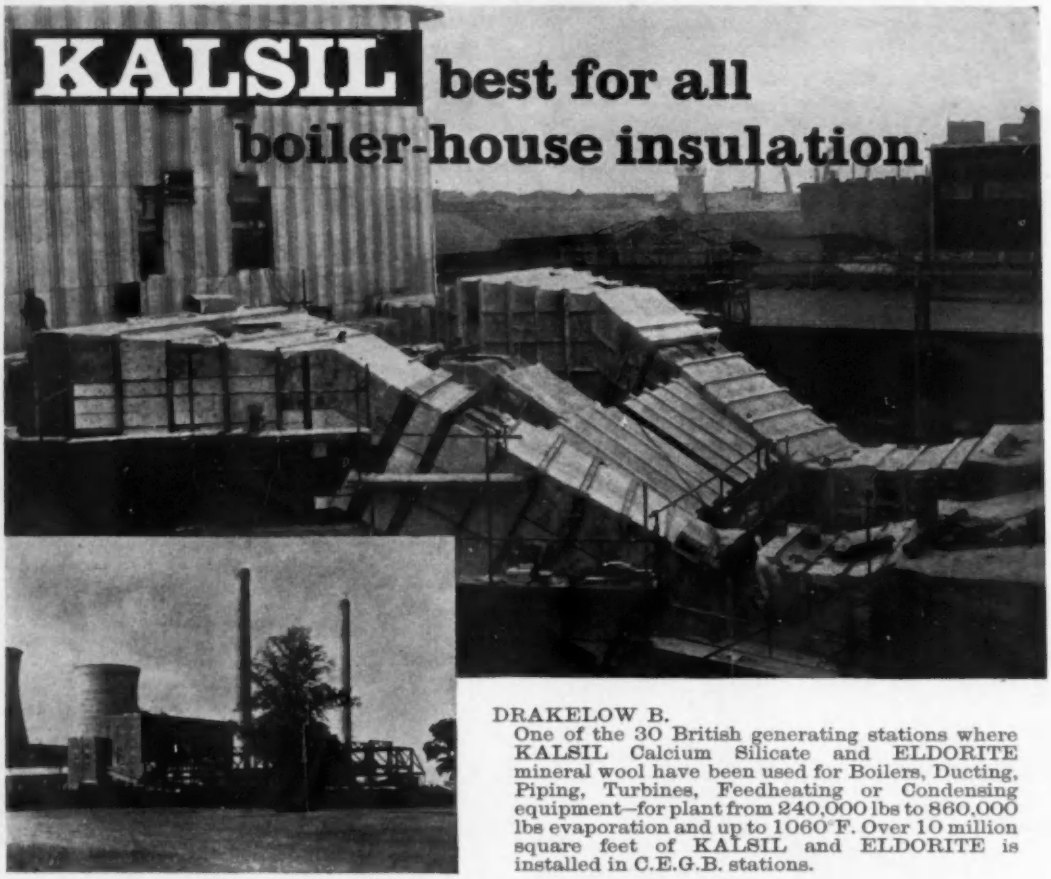
KALSIL best for all boiler-house insulation



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One of the 30 British generating stations where KALSIL Calcium Silicate and ELDORITE mineral wool have been used for Boilers, Ducting, Piping, Turbines, Feedheating or Condensing equipment—for plant from 240,000 lbs to 860,000 lbs evaporation and up to 1060°F. Over 10 million square feet of KALSIL and ELDORITE is installed in C.E.G.B. stations.

KALSIL offers these advantages

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- Thermal decomposition rate virtually nil.
- 100% mineral: contains no organic binder to burn or carbonise.
- Application is made direct—so cutting out extra time and cost of any intermediate H.T. insulation.
- High compressive and flexural strength.
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For controlled pipe movement . .

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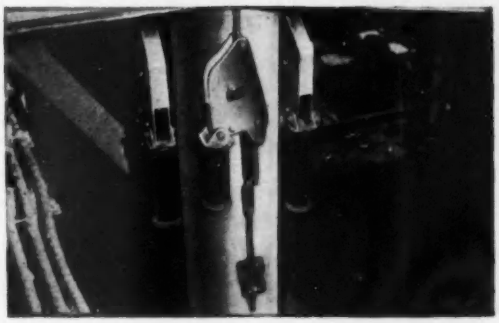
CONSTANT TENSION PIPE SUPPORTS



The Con-Ten system has not only been tested, but *proved* in industries and power stations all over the world. No matter what the load or the pipe movement, or the problems met, there is a Con-Ten to provide the most adequate and *permanent* support available. Loads from 100 lbs. to 14 tons and pipe movements up to 18" can be controlled by constant tension supports in the Con-Ten range. *Contact us now for full information.*

British Patent Nos. 474008 720074 720075 697987 816976
U.S.A. Patent No. 2129320

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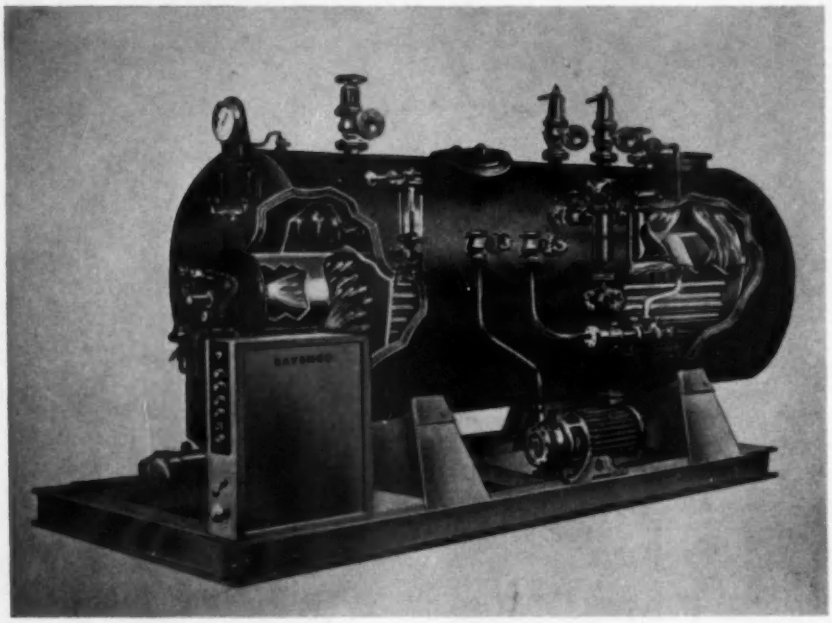
KAYENCO STEAM RAISING PLANT



Typical KAYENCO three pass Class 1 packed boiler. NOTE : *M.P.A. Burner with control cabinet. Twin Mobrey controls. Worthington Simpson feed pump. Corrugated furnace and substantial flanged mountings.*

The latest Kayenco development is a range of shell type boilers with capacities from 1,000 to 10,000 lbs. of steam per hour using gas or oil firing. KAYENCO Boilers have been thoroughly tested and proved for economy and reliability and are constructed to A.O.T.C. requirements Class 1. Write for details of these new boilers and our engineers will be glad to advise you on any heating problems using gas or oil fuel and waste heat recovery.

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From Boiler Back to Chimney Stack

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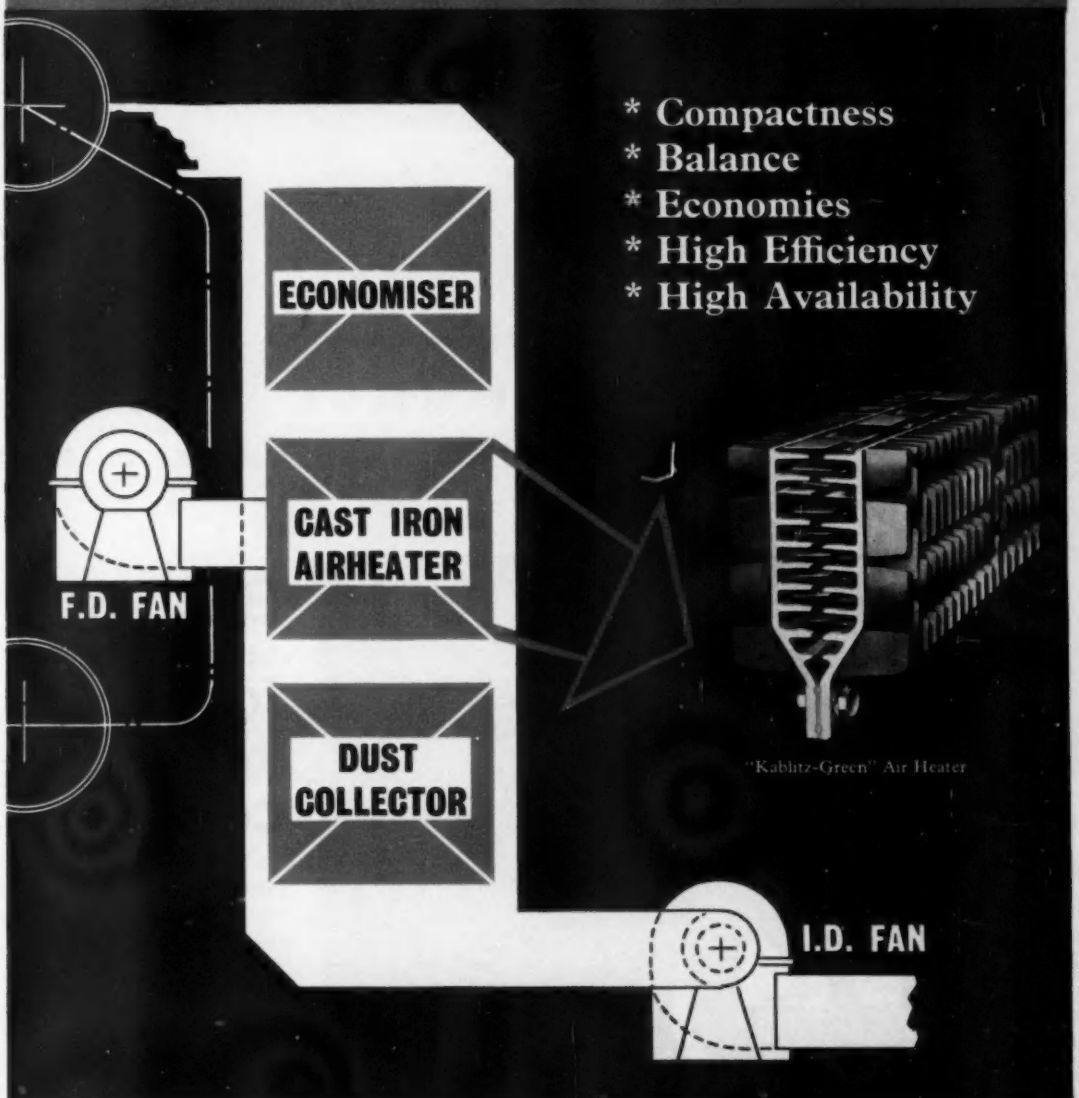

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* High Efficiency
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"Kablitz-Green" Air Heater

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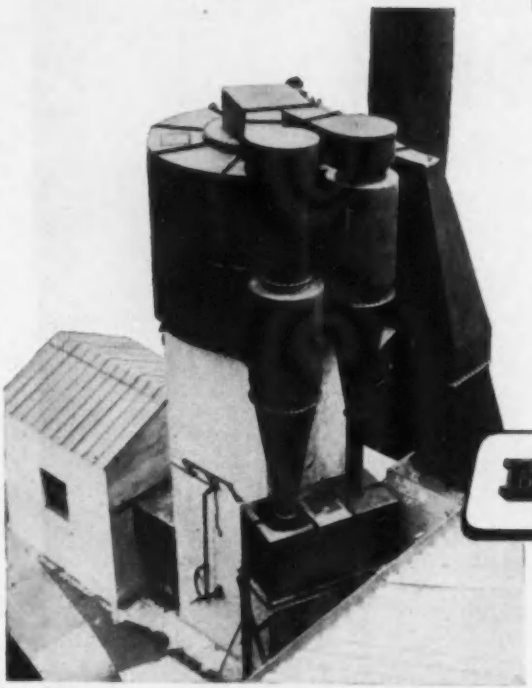

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COLLECTION AND REMOVAL

The Buell Compound Collector, Type AD is particularly suitable for the removal of ash from the exit gases of stoker fired water-tube and of shell boilers fired with small coal and forced draught. This type of Collector is extremely compact and will handle a considerable volume of gases with minimum resistance and comparatively low power consumption.

The Compound Separator combines a primary separator, which segregates most of the dust, in series with a high-efficiency secondary collector which completes the extraction of the finest particles.

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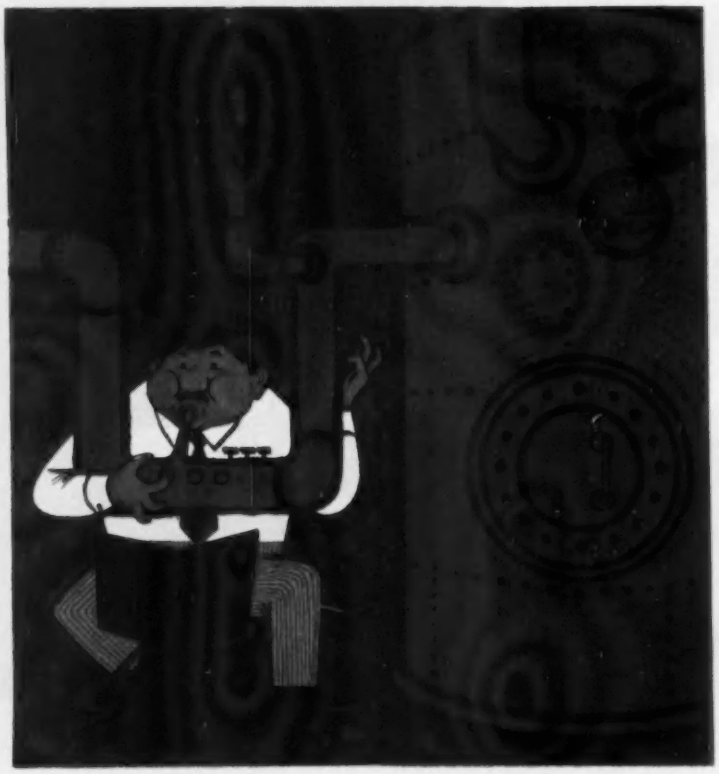

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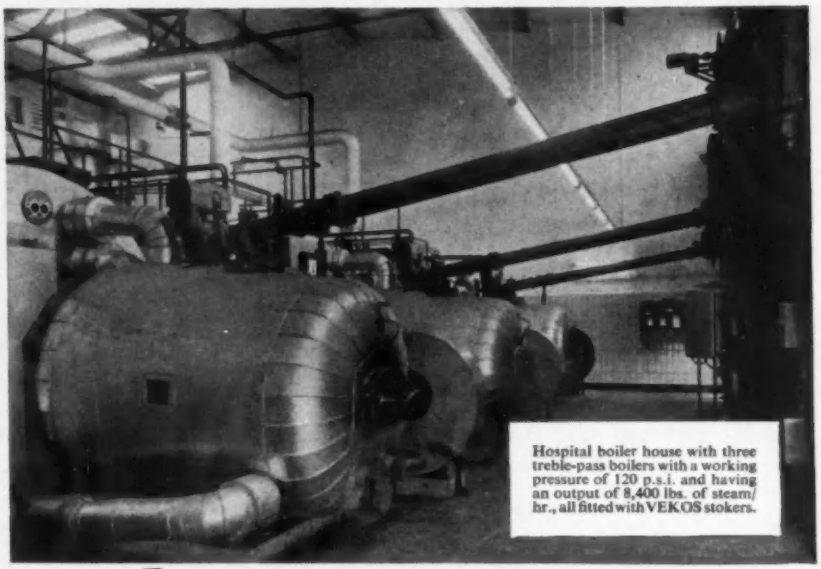

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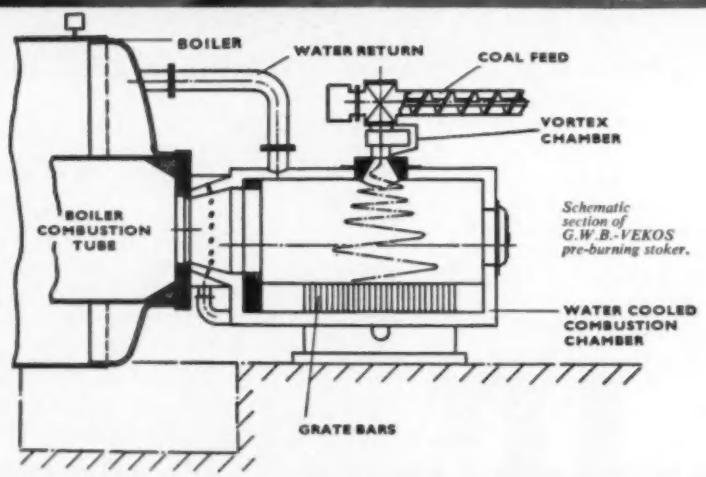

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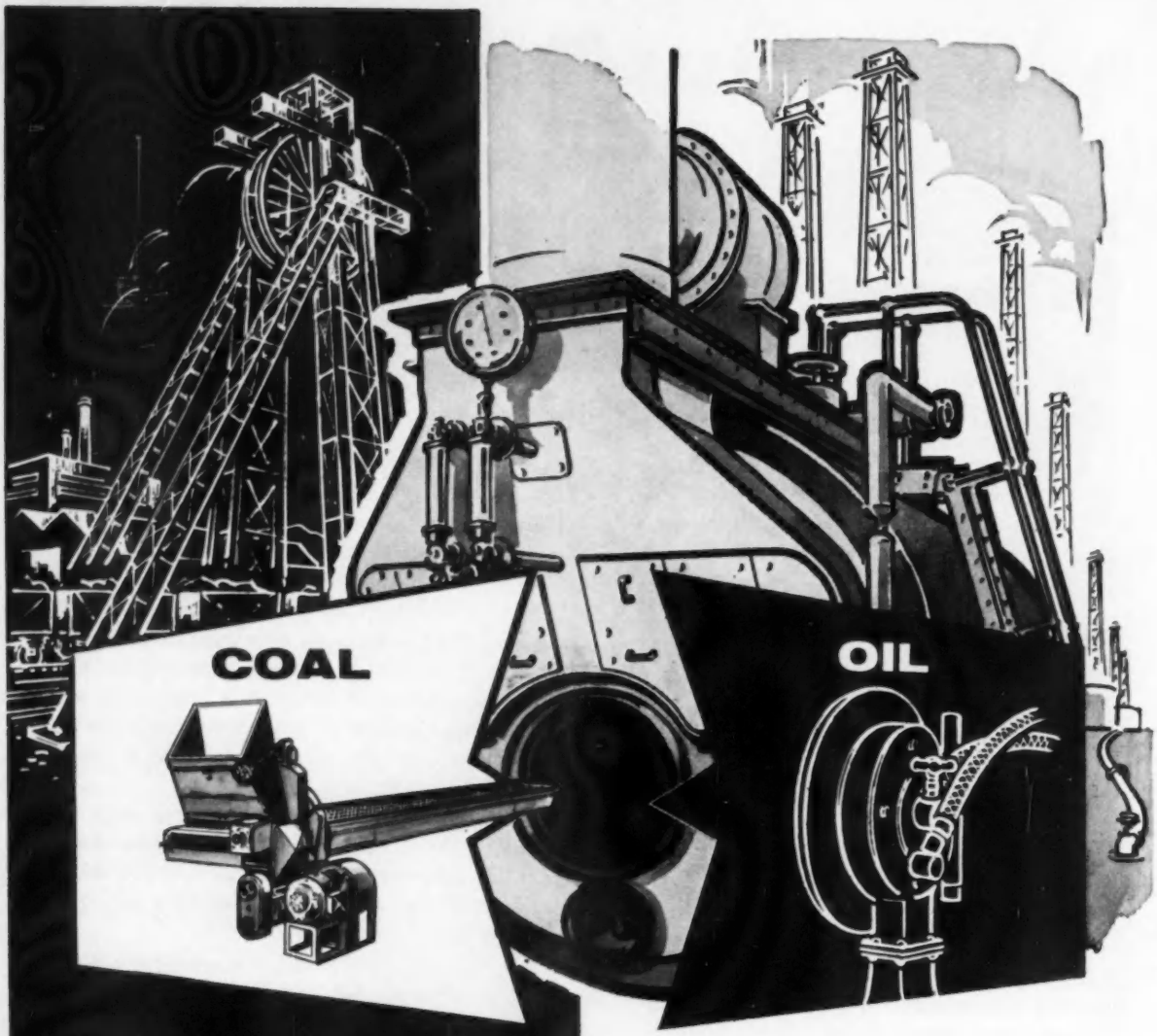

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Engineering and BOILER HOUSE REVIEW

THE OLDEST ESTABLISHED STEAM ENGINEERING PUBLICATION

NOVEMBER 1960

VOLUME 75. No. 11

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The Editor will be glad to receive and consider original contributions, correspondence, etc., of a suitable nature for publication. Stamped and addressed envelopes should be enclosed for the return of any matter considered unsuitable

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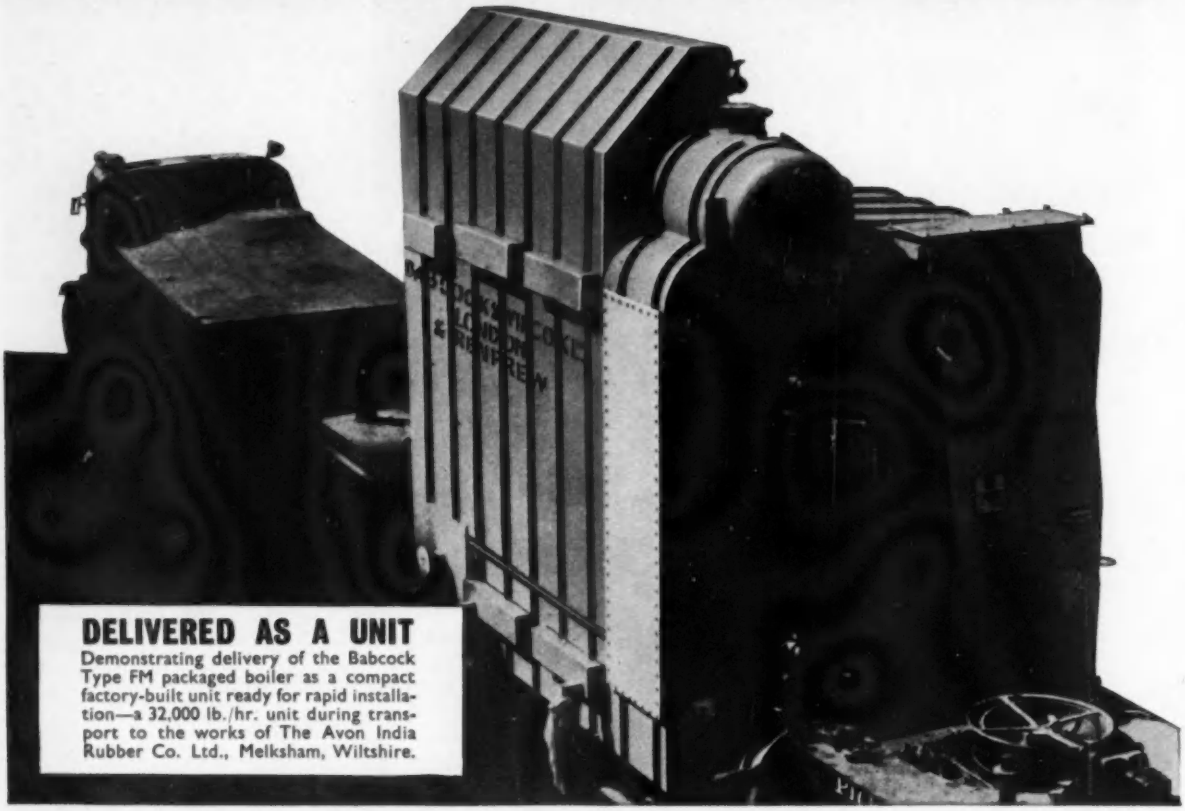

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NOVEMBER 1960
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ELECTRICITY SUPPLY AND RESEARCH

THE annual reports of the Electricity Council, and of the Central Electricity Generating Board, for the year ended March 31st, 1960, were published recently. Elsewhere in this issue we summarise some of the main points included in the report issued by the Board, whose plans for the development of generating and transmission plant are certainly impressive. There are on order several single-shaft turbo-alternator sets of 275-MW, 300-MW and 350-MW capacity respectively, as well as twin-shaft 550-MW sets for steam conditions of 2,300 lb./sq. in. and 1,050 deg. F. with reheat. Sets such as these can be looked to as standard machines for the future, as Sir Christopher Hinton, chairman of the Board, pointed out at a recent press conference. More recently orders have been placed for two 375-MW generating units to operate at a super-critical steam pressure of 3,500 lb./sq. in. and a temperature of 1,100 deg. F., with reheat to 1,050 deg. F. These units are to be installed at Drakelow " C " power station in the East Midlands Division of the Board. Furthermore, investigations have shown that a single-line turbo-alternator set of 550-MW capacity is practicable by about 1965. This substantial increase in the size of generating units, together with the associated increase in steam pressures and temperatures, is of special significance as it brings about an improvement in thermal efficiency and a decrease in capital cost per kilowatt of generating capacity installed.

In the case of super-critical sets, the gains are expected to be only marginal. In fact the capital costs will be only slightly greater than those of the " standard " sub-critical sets, but the difference will, it is considered, be more than offset by a gain in thermal efficiency and, therefore, in running costs, provided that the super-critical sets can be used for base-load operation.

But it is pointed out that well within their lifetime, however, those stations in which super-critical sets are installed, will become less economic for base-load operation than will the latest nuclear power stations then being commissioned. The super-critical stations will then be used for peak load operation and for such conditions may well be less economic than the earlier " standard " sub-critical sets.

Nevertheless, the super-critical sets are being ordered now because, as Sir Cristopher Hinton explained, they represent the next logical step in technical advancement and because experience with these advanced techniques will help British manufacturers in their efforts in the export markets—and also may tend to offset and relieve the sense of frustration resulting from the slowing down of the nuclear power plant programme. As regards research, the organisation of this is the responsibility of the Electricity Council whose duty it is, under the Electricity Act of 1957, to settle from time to time in consultation with the Minister of Power, a general programme of research, into matters affecting the supply of electricity and other matters affecting the functions of the Area Boards, the Generating Board or the Council. It is interesting to note that under the present regime, the total strength of the research staff has been trebled, and the cost of research has risen from £1,250,000 in 1958-59, to £2,202,000 for the year ended March 31st, 1960. Of the total cost, £1,403,000 was charged to revenue and £799,000 to capital. As well as the work carried out by the Electricity Boards themselves, the industry's research programme includes the financing of special research projects at universities and colleges, and substantial annual contributions to the funds of the British Electrical and Allied Industries Research Association, and other research organisations whose work is related to electricity supply.

In the field of education and training, the year under review is reported to have been one of consolidation combined with steady progress. Existing training schemes were widely used, and were revised to meet changing circumstances. The recent improvement achieved in the rate of graduate recruitment was continued, and a higher proportion of entrants had first or second class honours degrees.

For electricity supply scholarships (which are offered for existing employees, as distinct from the scholarships for school leavers), 75 applications were received, and 14 scholarships were awarded—four to manual, six to technical, and four to clerical and administrative staff. During the year, seven scholarship holders completed degree courses, one obtaining a higher degree, two obtaining first class honours, and four gaining " seconds."

Points and Pointers

SECOND NUCLEAR STATION ON RIVER SEVERN

The Central Electricity Generating Board have now received the consent of the Minister of Power to construct the proposed 550-MW nuclear power station at Oldbury-on-Severn, Gloucestershire. The site is located on the south-eastern bank of the Severn Estuary, about 14 miles north of Bristol, and four-and-a-half miles downstream from Berkeley, where one of the Board's first two nuclear stations is under construction. Application for the consent was made to the Minister in April, 1959. A public inquiry was ordered, and this was held at Thornbury, Gloucestershire, during April this year. However, because of the slowing down of the nuclear programme, the Oldbury station has been postponed from the 1965 to the 1966 programme, and completion in 1966 will still be possible, despite the long delay in obtaining consent. The contract for preliminary works will be placed within the next month, and work will commence almost immediately. The site at Oldbury covers approximately 180 acres and this area will be sufficient to permit extension of the station if required in the future. The Oldbury site was chosen by the C.E.G.B. for a number of important reasons. It is strategically placed to help meet the growing demand for electric power in central southern England as well as in Bristol and its suburbs. Only short transmission lines will be needed to connect it to the existing 275-kV supergrid near the Severn crossing, and to the Bristol area. Three other sites were investigated on the River Severn—at Aust, Tidenham and Portskewett. Oldbury was chosen because it was the only site for which it was possible at the present time to devise a practical solution to the problem of drawing and returning the large quantities of cooling-water needed for a station of this size. The other sites all posed complex cooling-water problems, which require further lengthy investigations. These are continuing, and in this connection, a large model of the Severn Estuary has been constructed at the Hydraulics Research Station. During the construction of the nuclear power station, which is the seventh for which the C.E.G.B. has received consent, a peak labour force of over 2,000 men will be required.

SYMPOSIUM ON THE USE OF SECONDARY SURFACES FOR HEAT TRANSFER WITH CLEAN GASES

During the past ten years, a great deal of work has been done on the development of extended surfaces as an aid to heat transfer. Much of the work has been directed towards the gas-cooled nuclear power reactor, which depends for its performance upon the extended surfaces on the fuel elements and on the heat-exchanger tubes. The Nuclear Energy Group of the Institution of Mechanical Engineers recommended to its Council that the work should be recorded and discussed at a symposium on the topic of the heat transfer characteristics of extended surfaces embodied in the fuel elements and the heat-exchangers of gas-cooled nuclear plants. The symposium, which is being held at the Institution on November 9th-10th, has been designed to give plenty of opportunity for both formal and informal discussion. There will be a general survey on the effect of heat transfer characteristics in reactors and heat-exchangers on overall design parameters by Mr. H. H. Gott, of the Central Electricity Generating Board, and the papers which follow fall into two main groups:—viz., heat transfer through extended surfaces in cross-flow, and fuel element heat transfer. The proceedings of the symposium will be reported at the 1961 International Heat Transfer Conference, now being arranged jointly by the Institution of Mechanical Engineers, and the American Society of Mechanical Engineers. This volume of proceedings, to be published soon after the symposium, should be a useful reference work, the first to be devoted to these specialised aspects of heat transfer. Two features of the symposium will be the reception, to be held on the evening of November 9th, which will provide an opportunity for those attending to meet and talk informally, and a small exhibition in the Institution entrance hall.

EXAMINATION OF STEAM BOILERS IN INDUSTRY

The frequency with which it is desirable from the safety point of view for different types of steam boilers to be examined, is discussed in the Report of the Advisory Committee on the Examination of Steam Boilers in Industry which was published as a White Paper on October 14th. (Cmd. 1173, H.M. Stationery Office, price 1s. 3d. net.) The committee was set up in May, 1958, under the chairmanship of Mr. G. G. Honeyman, C.B.E., Q.C., to consider "the existing legal provisions relating to the examination of steam boilers in industry in the light of modern developments in design and construction, the size of units installed, and the use of nuclear reactors as a source of heat, and to advise the Minister of Labour on any changes which appear desirable." Existing legislation contains detailed provisions governing aspects of the design, operation and examination of steam boilers, and requires that every such boiler installed in factory or works premises has to be thoroughly examined and certified by a competent person at least once every 14 months. During the war, this period was extended in some cases to 18 months, and a limited number of relaxations have continued to be granted since. A further change in the law was made by the Factories Act, 1959, which gives the Minister of Labour power to make special regulations requiring examinations at such intervals and in such manner as he might specify. The main issue, which, the committee state in their report, they had to consider was whether in the light of modern developments in design, operating conditions and maintenance, any change in the period of 14 months appeared to be justified. Evidence on this question which they heard included some about the metallurgical problems encountered in modern coal and oil-fired boilers operating at high pressures and temperatures, and also on the

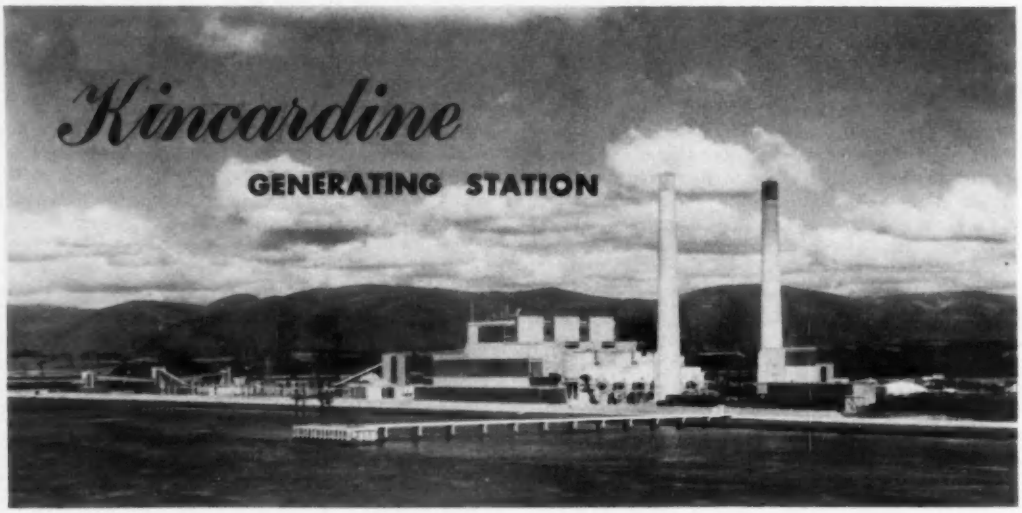
special problems of the examination of the boilers associated with nuclear reactors. In their summary of evidence, the committee point out that the provision of a period of 14 months for the examination of boilers was essentially one to secure annual examination. It had, in general, worked well, but had been criticised because of its generality as being unnecessarily stringent. It was argued that scientific and technical developments in the design of steam boilers, together with the improvement in testing techniques, maintenance and supervision had made it possible, without lowering standards, to require less frequent examination of some types. Three members, and the chairman, were of the opinion that, from past experience, large water-tube boilers with fusion-welded or solid-forged drums or headers, were very much safer than many other types of boilers, and needed to be examined at less frequent intervals. In their view, a convenient and valid criterion would be one based on evaporative capacity. They recommended that every boiler should be examined between eight and fourteen months, after being taken into use; that the period of subsequent examinations should be every 14 months after the first, except for water-tube boilers with fusion-welded or solid-forged drums or headers with an evaporative capacity of 50,000 lb. or more of steam per hour, when the period should be 26 months for the first 21 years of their operation after which it should be 14 months. Similar recommendations are made for a group of these types of boilers on a single site where the evaporative capacity of each boiler is 25,000 lb. or more per hour, or the total capacity of the group 100,000 lb. per hour or more, and for waste-heat boilers which are an integral part of a catalytic cracking plant or other large chemical or oil refinery processing plant. The committee also recommend that for boilers associated with nuclear reactors, there should be full consultation between the Ministry of Labour, the Ministry of Power and other interested bodies such as the United Kingdom Atomic Energy Authority before the issue of a licence for a nuclear installation; about the terms of that licence relating to examination of heat-exchangers; that for those heat-exchangers which can be isolated from the reactor vessel the first examination should be within 14 months and subsequently once every 26 months.

CLEAN AIR CONFERENCE

The annual conference and exhibition of the National Society for Clean Air was held at Harrogate from October 5th to 7th. Sir Hugh Beaver, who was chairman of the Government's committee on Air Pollution after the great London "smog" of 1952, gave the presidential address. Progress, he said, had not been as rapid as they had hoped, but nevertheless, it was being made. He praised industry for the efforts it was making, often at considerable expense, to reduce air pollution. Thus, all the new power stations were virtually smokeless, with very high performance grit-arrestment plants and high chimneys, upwards of 400 ft. The iron and steel industry had embarked on a very costly campaign to deal with emissions from ore dryers, sinter plants, blast-furnaces and the new techniques of steel production. The bottle oven kiln of the potteries was rapidly giving way to smokeless techniques. The afternoon session on the opening day of the conference was devoted to papers and discussions on air pollution from road vehicles. Thursday morning's session of the conference was given up to discussions by the scientists and technical experts. Messrs. W. D. Jarvis and D. S. Wilson (Central Electricity Generating Board) described the surveys conducted by the Board to find out the effects of smoke, dust and gases from power station chimneys. The authors described work carried out on the results of the pollution measurements which were published by the Department of Scientific and Industrial Research. The work showed that the national level of dust concentration had fallen considerably since 1950, but the concentration of sulphur dioxide gases had risen since 1952. The effect of power stations on the level of these gases was shown to be small, even when compared with the level of pollution in country areas. A group of four scientists from the Warren Spring Laboratory of the Department of Scientific and Industrial Research, also arrived at the conclusion that smoke, dust and gases from high chimneys, such as those at the newer power stations, made little contribution to pollution near ground level, which, for smoke, came mainly from domestic chimneys; or from industrial or domestic chimneys for sulphur gases. Another contribution, by Mr. F. P. Williams, showed that, "as far as smoke is concerned, the observed pollution is not connected in any way with the size of the town, and that nowadays, almost all the smoke came from domestic fires." Thursday afternoon's and Friday morning's sessions were concerned with the working of the Clean Air Act, particular attention being based upon the answers to questionnaires sent out to local authorities.

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS

The opening general meeting of the 77th session of the North East Coast Institution of Engineers and Shipbuilders, was held on October 17th, when Mr. J. B. Woodeson, O.B.E., was installed as president. Mr. Woodeson is chairman of Clarke, Chapman & Co. Ltd., a director of the Anglo Great Lakes Corporation, and of the Nuclear Power Plant Co. Ltd. He is also chairman of the Water-Tube Boiler Makers' Association. In the opening remarks of his presidential address, Mr. Woodeson drew attention to the strong Continental challenge both as regards technical advances, rate of productivity and selling price, and went on to say that no doubt the years of full order-books had induced a feeling of security, which made it difficult to face the current harsh facts of competition. Criticism and advice, mostly impractical, are offered by those outside the industry, and who do not have the task of actually finding a solution for economic difficulties, many of which stem from taxation hampering re-equipment schemes; while another fact is the lack of Government credit to assist the long-term financing, often essential to expand exports. Turning to the question of steam power generation, Mr. Woodeson reviewed briefly the progress made during the last decade, particularly calling attention to the increase in boiler capacity and to thermodynamic development, and to the part played by metallurgy. Units for raising steam at 3,650 lb. per sq. in. gauge, and 1,110 deg. F. are to be built, while new alloys are being developed to permit of temperatures above 1,250 deg. F. Improved efficiency had reduced the amount of copper and steel per MW of generating capacity installed, while increases in fuel costs had been largely absorbed.



KINCARDINE generating station, which was formally opened by Her Majesty The Queen on October 12th, is the largest station owned by the South of Scotland Electricity Board. It will, when completed, have an installed generating capacity of 760-MW—the plant comprising three 120-MW, and two 200-MW turbo-alternator sets, and three 860,000 lb./hr., and two 1,350,000 lb./hr. unit boilers. The station is located on the north bank of the River Forth on the upstream side of the Kincardine-on-Forth road bridge, and almost ten miles south-east of Stirling. The sidings, coal-storage area, switching compounds and main and ancillary buildings, collectively occupy an area of approximately 137 acres. The river at this point is tidal, but is of sufficient depth to ensure that at all stages of the tide, there is an adequate supply of water for cooling purposes, thereby obviating the need for cooling towers. The normal tidal range of the river is about 17 ft. with a recorded extreme of 25 ft. and, as the station basement level is + 5.00 o.d., pumping costs for the circulating-water supply are very low.

The original access to the site was through the narrow streets of Kincardine, and by way of a light bridge over the adjacent railway line. A new access road had to be built, and this now connects the site directly with the main Kincardine-Alloa road, and spans both the British Railways' line and the power station railway line connecting the reception and exchange sidings. Because the site lies below high-tide level, and is comparatively flat with a high water-table, drainage has received special consideration. The site drainage, including rain-water from the roofs of buildings and the effluent from various items of plant, lead to a surface-water pump-house via an underground storage-tank of approximately 250,000 gallons capacity, designed to fill when the flow in the main drain exceeds a certain depth. At the pump house, four 6,000 gal./min. pumps arranged to operate and cut out at predetermined water-levels in the suction chamber, discharge the surface water through twin 36-in. dia. pipes to the river. A sewage treatment plant consisting of the usual arrangement of settling tank, septic tanks, humus beds and filter beds has been provided, the wet sewage being pumped from septic tanks into the filter beds by compressed-air. This pump can also empty the sludge into tankers when required.

Kincardine generating station was originally planned by the former British Electricity Authority, to meet the increasing demand for electrical power in central Scotland. Statutory consent to build the station was received by the South of Scotland Electricity Board on April 1st, 1955, the day the Board came into being under the Electricity Reorganisation (Scotland) Act, 1954. The location of the station was influenced by the availability of an adequate supply of suitable coal which was planned to be made available from the nearby Fife and Clackmannan coalfields, as a result of the National Coal Board's proposed expansion programme in that area. The station is one of the first two in Britain to be designed to incorporate 120-MW units operating at the advanced steam conditions of 1,500 lb./sq. in. and 1,000 deg. F. at the turbine stop-valve ; the steam, during its passage through the turbine, being returned to the boiler and re-heated to that temperature. It was at first intended to install six such units, and three are, in fact, now in operation. Instead of proceeding with the installation of three further 120-MW sets, the Board have decided to complete the station with two 200-MW units designed to operate at the more advanced steam conditions of 2,350 lb./sq. in. and 1,050 deg. F. with reheat to 1,000 deg. F. These machines will generate at a higher efficiency and, as a result, the combined coal consumption of the two associated boilers will be no greater than the total for those serving the first three 120-MW units—although the output will be 10 per cent. greater. The station will reach its ultimate generating capacity of 760-MW in 1963.

Construction work commenced on the site in June, 1955—the first 120-MW set was commissioned on

December 28th, 1958 (44 months after the first contract for the access road was placed), the second set in mid-1959, and the third on August 24th this year. The main and ancillary buildings are of steel-framed construction, with a light cladding of aluminium; glass with brickwork comprises the lower portions. The station basement slab is constructed in mass-concrete, and incorporates (running longitudinally through the station) culverts 8 ft. 6 in. square, for conveying the circulating-water to and from the condensers. The turbine house for the complete station is 544 ft. long by 382 ft. wide and 90 ft. high, and the complete boiler house 544 ft. by 193 ft. by 160 ft. high. The combined volumes of the buildings give a figure of 28 cu. ft./kW of installed capacity for the complete station. The boilers are slung near roof-level from the main structural steelwork, which is shop-welded and site riveted, the greatest load on any one column supporting the first three boilers being 1,760 tons.

The three 120-MW turbo-alternator sets are arranged transversely in the turbine house, but the two 200-MW sets will, because of their lengths, be arranged longitudinally. The boiler house lies to the east of the turbine house, and is separated from it by an annexe containing the feed-pumps, plant control rooms, de-aerators and reserve feed tanks. On the remote side of the boiler house is the bunker bay which also contains the milling plant. Switchgear and transformer annexes flank the main station building, the one on the west side containing the main electrical control room. The alternator transformers stand outside the building on the west-side facing the grid substation. The precipitators and induced-draught fans are situated to the east of the main building, and beyond are the main flue, the two chimneys and the ash and dust plant house. The administration and workshop block is on the south-side and lies between the main building and the river. Space heating is provided by a 864-kW electrical floor warming installation which operates as an "off-peak" load. Each of the two brick chimneys which were built by P. C. Richardson (Middlesbrough) Limited, are 400 ft. high with an internal dia. of 24 ft. at the top and an external dia. of 45 ft. at the base. They are built on concrete bases founded on rock and are lined with 4½ in. acid-resisting brick. The estimated cost of the complete station is £36¼ million—equivalent to £47.7 per kW for the total 760-MW of installed capacity. Approximately 450 employees will ultimately be employed for the operation of the station, which, when completed by mid-1963, will supply about 48 per cent. of the total units required by the Board.

Coal-handling plant

The weekly consumption of coal for the completed station will be approximately 55,000 tons/week, or 2,200,000 tons/annum. The coal, of an average calorific value of 9,700 B.Th.U./lb., is supplied by rail, and sidings have been installed to provide facilities for handling up to 375 wagons per day. A ground hopper for receiving road-borne coal is provided for emergency use. The present coal storage area is 13 acres in extent and can store 160,000 tons of coal at an average depth of 12 ft. The area is being extended, and will ultimately store approximately 250,000 tons.

The complete coal-handling plant was supplied by Simon-Carves Limited, Cheadle Heath, Stockport. For dealing with flat-bottom rail wagons there are two marshalling systems, each comprising an inhaul and an out-haul beetle serving two dust-trapping side-discharge wagon-tipplers (supplied by Strachan & Henshaw Limited), each tippler having a weighbridge and being capable of discharging wagons of up to 24½ tons capacity into receiving hoppers. Hopper-bottom wagons are marshalled by diesel locomotives on to three spurs of the sidings, weighed on any of three track weighbridges, and discharged into any of three filler pits. A wagon discharger is installed above each pit for emptying flat-bottomed wagons if required, and dust-extraction plant is also provided. Coal is conveyed from the tippler hoppers and filler pits to No. 2 junction tower by two lines of conveyors, each of 600 tons/hr. capacity; two of these conveyors can also convey road-borne coal to the junction tower. Run-of-mine coal is passed through screening and crushing equipment in the tower to a balance hopper; small coal is by-passed direct to the same hopper. Two lines of conveyors, each of 600 tons/hr. capacity, take coal from the hopper to the boiler house bunkers. For stocking-out purposes, coal is conveyed by a single line of conveyors of 1,200 tons/hr. capacity to No. 6 junction tower, where it is divided into two equal streams to No. 8 and No. 9 towers, from each of which it is stocked out by a radial conveyor. The coal piles formed from the radial conveyors are spread over the stocking area by bulldozers, these also being used to reclaim coal into two hoppers adjacent to the two distributing towers. From each of these hoppers the coal is returned at 600 tons/hr. to No. 6 tower, from which a single conveyor line transfers it at 1,200 tons/hr. via No. 5 into the balance hopper at No. 2 tower; from which point it passes to the boiler-house bunkers.

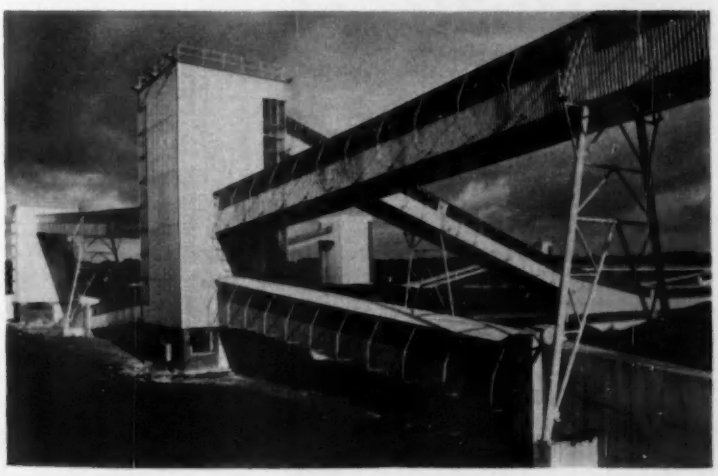


Fig. 1. The complete coal-handling plant comprising twenty conveyors and associated equipment was supplied by Simon-Carves Limited. The conveyors are remotely controlled from a central panel in No. 2 tower and they are all sequence interlocked.

The rate of feed from all hoppers is controlled by vibrating feeders, supplied by G.E.C. Limited.

The complete plant comprises 20 conveyors with a combined centre distance of more than 1½ miles, and the whole system is fully-interlocked. On arrival at boiler bunker level, the coal is discharged from the conveyor belts by means of automatic travelling belt trippers, which may be controlled to feed one or more bunkers as required. There is one granite-lined bunker of 1,400 tons capacity for each of the first three boilers. The driving motors for the coal-handling plant were supplied by The English Electric Co. Ltd. Vulcan-Sinclair fluid couplings of the traction type and supplied by Fluidrive Engineering Co. Ltd., are used for driving the four Strachan & Henshaw beetle winches, two being size 16.25 rated at 25 h.p. at 960 r.p.m., and two size 12.75 rated at 7½ h.p. at 960 r.p.m. Both Strachan & Henshaw Rotaside Tipplers are driven through size 23 traction couplings, transmitting 45 h.p. at 730 r.p.m. Likewise, 15 of the Simon-Carves conveyors are driven through fluid couplings ranging from size 17.75 to size 23, and in power from 30 h.p. to 135 h.p. For the extension of the plant, three further Simon-Carves coal-handling conveyors are being installed, driven through traction-type fluid couplings which range in power transmitting capacity from 65 h.p. to 120 h.p. at 950 r.p.m.

Boiler plant

Each of the first three boilers has a c.m.r. of 860,000 lb./hr. when supplied with feedwater at a temperature of 446 deg. F. Steam conditions at the superheater outlet are 1,600 lb./sq. in. and 1,010 deg. F., with reheating from 697 to 1,005 deg. F. All three boilers are of the natural circulation water-tube radiant type, with water-cooled combustion chambers designed to burn pulverised coal of average calorific value, 9,700 B.Th.U./lb. and an ash content of up to 20 per cent. The single-drum boiler for No. 1 unit was supplied by International Combustion Limited. The volume of the combustion chamber is 82,100 cu. ft. and furnace heating surface 16,295 sq. ft. The whole boiler is slung from the steelwork of the main building—the total weight being approximately 2,500 tons. The automatically-controlled Melesco superheater and reheater was designed and manufactured by The Superheater Co. Ltd., to give a final steam temperature of 1,010 deg. F. at 1,600 lb./sq. in. over the range 430,000/860,000 lb./hr. The reheater is designed to raise the temperature of the reheat steam from 690 deg. F. to 1,005 deg. F. at 400 lb./sq. in. over the range 510,000/785,000 lb./hr. The superheater comprises primary and secondary sections—the two stage primary superheater (35,920 sq. ft.

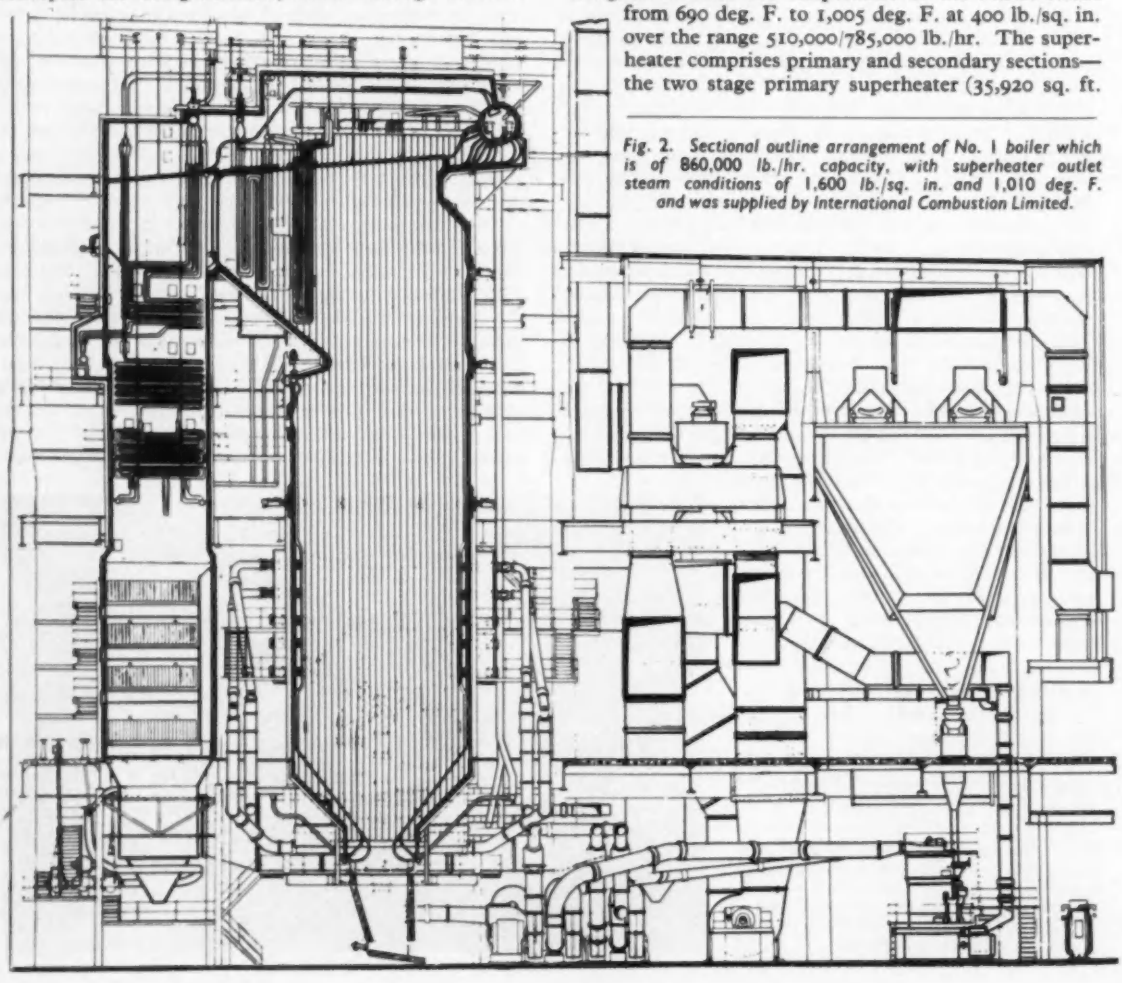
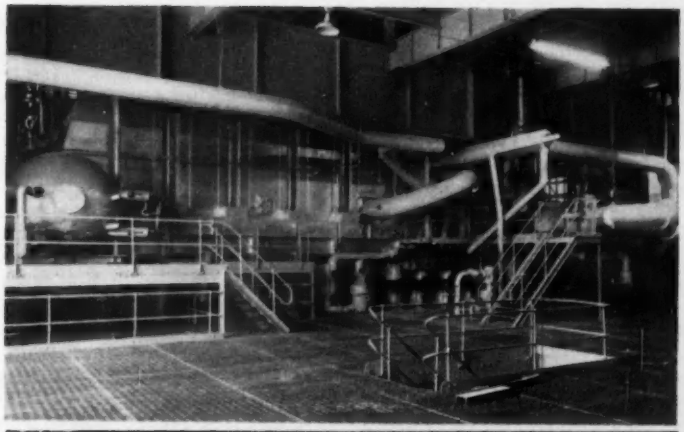


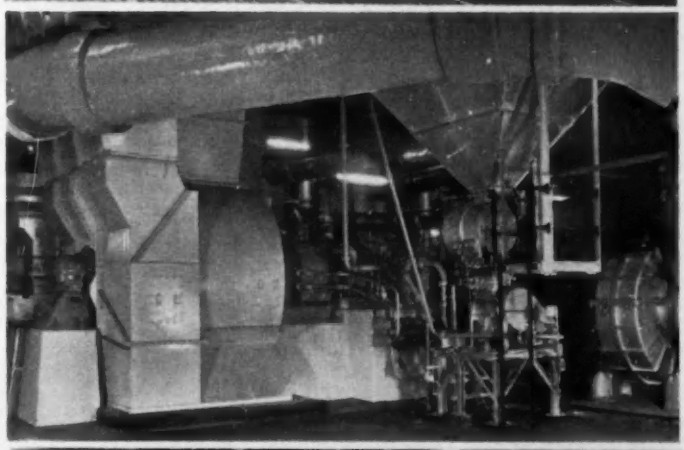
Fig. 2. Sectional outline arrangement of No. 1 boiler which is of 860,000 lb./hr. capacity, with superheater outlet steam conditions of 1,600 lb./sq. in. and 1,010 deg. F. and was supplied by International Combustion Limited.

effective surface) being of the horizontal self-draining type; while the secondary (7,540 sq. ft. effective) located at the furnace outlet, is divided into two sections and is of the pendant type. The saturated steam flows by multiple connections from the drum to the distributing header at the top of the primary superheater chamber, from which it is led by a system of support tubes and wall tubes to two primary inlet-headers at the bottom of the primary superheater. These saturated-steam tubes thus form the steam-cooled front and rear walls of the primary superheater and reheater gas-pass. The remainder form steam-cooled supports for the primary superheater and reheater elements. MeLeSco spray-type desuperheaters are arranged between the primary outlet and secondary inlet headers. These connections are so arranged that the left-hand primary feeds the right-hand secondary and vice-versa.

The two-stage reheater is located between the primary and secondary superheaters and is of the horizontal self-draining type. The reheater elements are supported from the saturated steam-cooled tubes previously referred to. A damper-controlled by-pass is provided to permit by-passing of the gases around the rear of the reheater elements before passing over the primary superheater. Spray-type desuperheaters for emergency use are installed at each side of the reheater inlet header.

The final steam temperature is automatically-controlled by the two intermediate MeLeSco steam-atomised spray-type desuperheaters previously mentioned,





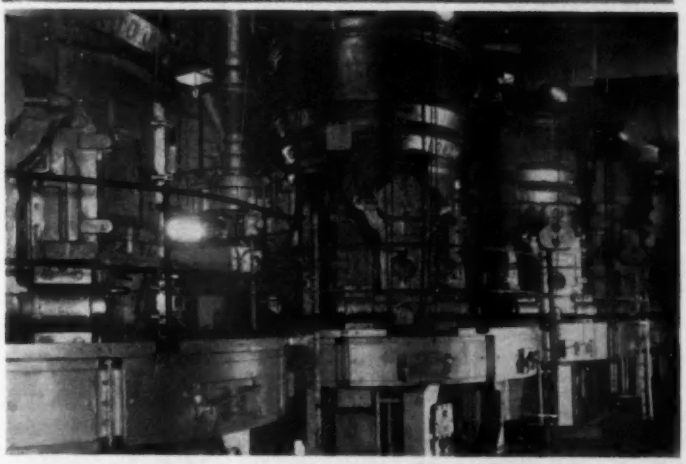


Fig. 3 (above right). View at drum level of No. 1 boiler unit which was supplied by International Combustion Limited.

Fig. 4 (centre). View in basement showing one of the F.D. fans driven through a Vulcan-Sinclair fluid-coupling. Also seen is an air-heater hopper, below which is a fly-ash loading point for the pneumatic fly-ash extraction plant.

Fig. 5 (right). There are five Lopulco type LM16 mills serving No. 1 boiler and they feed 20 corner firing tilting burners.

whilst the reheat steam temperature is automatically controlled by tilting burners. An additional means of reheat regulation is provided by the reheater by-pass damper which is remote-manually controlled. Inert flue gas recirculation is provided as an additional means of control of steam temperatures. The temperature control apparatus was supplied by George Kent Limited. For automatic control of reheat by tilting burners a single Multelec Mark II recorder-controller is employed. The reheater spray desuperheaters for bias control and emergency outlet temperature control are remote-manually air-operated, as is the reheat by-pass damper. The two spray type desuperheaters for superheat control are each operated through Multelec Mark II recorder-controllers, with provision for remote manual control if required.

The gilled-sleeve economiser, supplied by Senior Economisers Limited, is divided into four banks, and has an effective heating surface of 126,298 sq. ft. On-load cleaning of the boiler is effected by automatic sequence electrically-operated soot-blowers supplied by Ivor Power Speciality Co. Ltd.—there being 20 retractable—gun-type blowers for cleaning the furnace tubes, and 10 retractable lance blowers for the superheater and reheater.

Draught plant and airheaters

Air for combustion for each of the first three boilers is drawn from the top of the boiler house by two forced-draught fans located in the basement. Each of the fans for No. 1 boiler is of 172,000 cu. ft./min. capacity, while those for boilers 2 and 3 are each of 160,000 cu. ft./min. capacity. All these fans were supplied by James Howden & Co. Ltd.—those on No. 1 boiler being driven by 495 h.p. 6.6-kV Bruce Peebles motors, and those for boilers Nos. 3 and 4 by 445 h.p., 6.6-kV, A.E.I. motors—all fans being driven by means of Vulcan-Sinclair scoop-control fluid couplings supplied by Fluidrive Engineering Co. Ltd. These couplings for all six fans comprise two size-32 or 495 h.p. at 990 r.p.m. for the fans of No. 1 boiler, and four size-36 of 445 h.p. at 730 r.p.m. for the fans serving boilers 3 and 4. In each case the range in speed regulation is approximately 5 : 1. After combustion of the fuel, the gases traverse the various sections of the superheater, reheater, economiser, air-heater, grit-collectors and electrostatic precipitators, and are discharged to the chimney by the induced-draught fans. For No. 1 boiler the two Howden 270,500 cu. ft./min. I.D. fans are driven by Bruce Peebles 1,017 h.p., 6.6-kV motors, while the four for boilers Nos. 2 and 3, which are of 242,000 cu. ft./min. capacity, and also supplied by James Howden & Co. Ltd., are driven by 860 h.p., 6.6-kV, A.E.I. motors. All six I.D. fans are driven through size-36 Vulcan-Sinclair fluid couplings at 970 r.p.m.

The F.D. fans supply air to the burners and mills via Howden rotary regenerative preheaters. At present there are six of these preheaters (size XZS 24½), installed in the station. Two of these are installed with the International Combustion boiler (No. 1), and four with the two boilers supplied by John Brown Land Boilers Ltd. (Nos. 2 and 3). In the case of the International Combustion boiler, the preheaters' total heating surface of 216,000 sq. ft. handles 1,322,000 lb./hr. of flue gas and 1,122,500 lb./hr. of air, reducing the gas temperature from 544 to 264 deg. F. and heating the air from 90 to 407 deg. F. The two preheaters on each of the John Brown boilers have a combined heating surface of 283,000 sq. ft., and they pass 1,237,000 lb. of flue gas and 982,000 lb./hr. of air. Here, the somewhat higher gas-entering temperature of 675 deg. F. is reduced to 280 deg. F., with an accompanying air rise from 90 to 593 deg. F.

Two Howden preheaters with a combined heating surface of 404,000 sq. ft. are on order for each of the two Babcock & Wilcox boilers (Nos. 4 and 5) to be installed at the station. With these preheaters, 1,908,000 lb./hr. of flue gas will have its temperature reduced from 590 to 255 deg. F., while 1,520,000 lb. of air will be heated from 90 to 572 deg. F.

For boiler No. 1 there are four Howden multivortex collectors used as pre-collectors to the electrostatic precipitators, each handling 107,500 cu. ft./min. of flue gas at temperature of 264 deg. F. at boiler c.m.r. The Howden multivortex collector consists of a primary concentrator unit and a secondary collector unit of Howden Centicell design, both of which are housed in

Fig. 7. (above). Plant control room showing panels for No. 1 boiler/turbo-alternator unit.

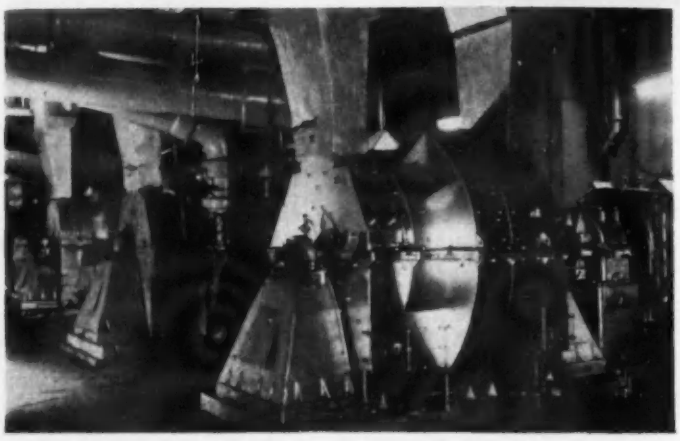


Fig. 6 (left). There are four p.f. mills for each of boilers 2 and 3, and they are of the Brown-Riley Duplex type each consisting of a combined mill and exhauster, which deliver the coal to 16 burners in the front wall of the furnace.

one casing. The primary cells concentrate the dust into a small volume of the main gas-flow which is drawn down into the secondary collector and separated out. A small fan to overcome the resistance of the secondary unit returns the clean gas into the clean side of the main gas stream. For each of the boilers Nos. 2 and 3, there are four Howden multivortex collectors used as pre-collectors with the precipitators, each handling 98,500 cu. ft./min. of flue gas at temperature of 280 deg. F. at boiler c.m.r. A total of eight Howden-Lurgi precipitators, in association with eight multivortex type mechanical pre-collectors, will be installed on boilers 4 and 5. Each of these precipitators is designed to handle 150,000 cu. ft./min. of gas from the boilers at a temperature of 255 deg. F. with an expected dust-collecting efficiency of 98 per cent. The combined mechanical collector and precipitator efficiency is expected to be 99.3 per cent.

The first three boilers are provided with twin Lodge-Cottrell precipitators, supplied by Lodge-Cottrell Ltd., each consisting of three banks of electrodes in series, operating at approximately 50,000 V d.c. Each bank is fed by a separate transformer-rectifier set, thus giving flexibility of control. The precipitators are of the " catch-pocket " horizontal-flow type, and the rapping gear on each bank is set to run at different speeds so that the re-entrainment of the dust particles is avoided. In the case of No. 1 boiler, the plant is designed to deal with a gas volume of 421,000 cu. ft./min. at a temperature of 272 deg. F., with a concentration of dust in the inlet of 9.47 gr./cu. ft. N.T.P. and to give a guaranteed efficiency of 99 per cent. at c.m.r. In the case of boilers Nos. 2 and 3, the plant is designed to deal with a gas volume of 394,000 cu. ft./min. at a temperature of 280 deg. F., with a concentration of dust at the inlet of 8.55 gr./cu. ft. N.T.P. and to give a guaranteed efficiency of 99 per cent. at c.m.r.

In the case of No. 1 boiler, coal is fed to the mills via Simon automatic weighers to feeders mounted on the mill casing. Five Lopulco LM-16 mills, supplied by International Combustion Limited, are provided for this boiler, but four mills can sustain the full boiler load—the fifth being available as a standby unit. These mills are driven by 200 h.p., 514 V Laurence Scott induction motors, at 1,480 r.p.m. The two-stage mill exhauster fans (Type DE), also supplied by International Combustion Limited, are of 79,800 lb./hr. capacity and they deliver the fuel to four sets of tilting burners situated at the corners of the combustion chamber for corner-firing.

Boilers No. 2 and 3

In general, the lay-out and conditions of Nos. 2 and 3 boilers, which were designed and supplied by John Brown Land Boilers Limited, are similar to No. 1 boiler. But in these units the first section of the secondary superheater is situated in the radiant zone at the top of the front wall and in platens suspended from the roof of the combustion chamber. The remaining section is in the convection zone, followed by the primary superheater and reheater arranged in parallel gas paths before the economiser. The milling equipment consists of four high-speed horizontal spindle attrition-type pulverisers of the Brown-Riley Duplex type, each consisting of a combined mill and exhauster, which deliver pulverised fuel to 16 burners in the front wall of the furnace. Three Duplex pulverising mills are sufficient for full-load operation. These mills are driven by 600 h.p., 6.6-kV, 985 r.p.m. Lancashire Dynamo & Crypto motors through induction gearing. Whilst the superheater outlet temperature is controlled by water sprays in a similar manner to No. 1 boiler, the reheater outlet temperature is controlled by altering the proportion of gas flow over the reheater and primary superheater by means of dampers. In these units (2 and 3) the combustion chamber volume is 75,700 cu. ft., the boiler heating surface 4,800 sq. ft., the primary superheater surface (effective) 43,500 sq. ft., and that of the pendant type secondary superheater—pendant 4,600 sq. ft. (effective) and radiant 9,450 sq. ft. (effective). The heating surface of the reheater is 40,600 sq. ft. The continuous steel-tube economiser has a heating surface of—main-pass 39,000 sq. ft., and by-pass 1,500 sq. ft.

The soot-blower installation on these boilers (Nos. 2 and 3), for on-load cleaning, is a Clyde fully-automatic sequentially-operated unified Lectramek control system supplied by Clyde Blowers Limited, and comprising rack-type long traverse blowers, retractable single-nozzle blowers, and multi-jet blowers. There are six single-nozzle retractable blowers on the furnace walls, 18 long retractable blowers for cleaning the superheater and reheater sections, and light multi-jet blowers for the air-heaters.

Babcock & Wilcox Limited are supplying the boilers for the 200-MW sets (Nos. 4 and 5). Each of these Radiant-type units will have a c.m.r. of 1,350,000 lb./hr., the superheater outlet pressure will be 2,450 lb./sq. in. and the temperature 1,055 deg. F. with reheat to 1,005 deg. F. Each boiler will be p.f. fired by 18 circular-type burners fed by six high-capacity Babcock type "E" mills.

The high-pressure valves and mountings for the first three boilers were supplied by Hopkinsons Limited. Each boiler has two direct-mounted water-level gauges, two remote combined level gauges and alarms, and a level recorder in the plant control room. There are four torsion-bar safety-valves on each boiler drum, and three on the superheater. There are also various Hopkinson-Ferranti valves, and Hopkinson parallel-slide valves, automatic isolating valves, non-return valves, " Nolos " steam traps, etc. An Igema remote level-indicator, supplied by James Gordon and Co. Ltd., is provided for each boiler, and is located at operating floor level adjacent to the feed control valves.

Automatic control equipment

Automatic boiler combustion control for all three boilers is effected by Bailey pneumatic systems supplied by Bailey Meters and Controls Ltd. The Master pressure controller initiates the system of combustion control and converts the measurement of steam pressure into an air signal which is transmitted to the general control scheme affecting the speed of the F.D. fans. The measurement of steam flow is used as a measure of heat input, and consequently of fuel consumed, and is obtained by means of two flow-nozzles installed in the superheater outlets to provide a final recording of the total boiler evaporation. The combustion air flow is measured by the suction created in each forced-draught fan inlet and separate oil-sealed mechanism units are mounted in the totalised steam-flow/feed-flow controller and totalised

steam-flow/totalised air-flow controller, the totalising mechanism being accommodated within the latter instrument. In addition to controlling the speed of the f.d. fans, the master signal is used to operate the p.f. mill. The signal passes through an accelerating relay which speeds up the rate of response of the mill circuit to a mill ratio relay. The purpose of the mill ratio relay is to correct for the number of mills operating. Its effect is such that for the same variations in load, hence the same output signal from the master pressure controller, the overall response for similar load fluctuations (steam pressure) will be generally similar irrespective of the number of mills operating. This mill ratio relay is set by the operator to correspond to the number of mills operating. The furnace draught is maintained stable by a furnace draught controller incorporating a sensitive diaphragm mechanism connected to the boiler furnace. With every change in boiler load, the output of the induced-draught fan is modified proportionally by the signal transmitted from the furnace draught controller. The master signal is also introduced into this signal, to give anticipation to changes of load.

Feedwater control

The three-element system of feedwater control incorporated the measurement of feedwater to the boiler and steam output. The totalised steam flow and the feed flow are balanced against each other by means of a differential linkage mounted in the totallised steam flow/feed flow controller. When the rate of feedwater input drops below or rises above the rate of steam output, an air signal will be made to open or close the feedwater regulating valves.

Bailey Meters and Controls Limited are also to supply the complete unit panels and control system for the Babcock boilers (Nos. 4 & 5); but these controls will differ from those supplied to the first three boilers in that they will be of the Bailetronic type instead of the pneumatic type of control.

Steam and feed piping

The h.p. steam and feed piping was supplied by Aiton & Co. Ltd.—the design of the former being based on superheater outlet conditions of 1,720 lb./sq. in. and 1,010 deg. F. Twin 8 in. bore by 1¼ in. thick mains in chromium/molybdenum/vanadium steel are used, all pipe joints being butt-welded. Piping carrying the steam to the reheater is of carbon steel, with twin leads, 15 in. bore by 19/32 in. thick, while that carrying steam from the reheater comprises twin 16 in. bore by 11/16 in. thick chromium/molybdenum/vanadium steel mains designed for a pressure of 365 lb./sq. in., and a temperature of 1,005 deg. F. Aiton "Uniload" constant-load supports have been provided to accommodate the vertical movements due to thermal expansion of all steam piping. The h.p. feed piping comprises 12¾ in. outside dia. by 1½ in. thick carbon steel, suitable for a design pressure of 2,300 lb./sq. in. at 441 deg. F. Aiton & Company also supplied the extensive system of low-pressure pipework services, this being of both steel and cast-iron. The whole of the insulation work on the first three boilers was carried out by The Darlington Insulation Co. Ltd., and included the insulation of drums and headers, external ducting, h.p. steam and feed piping p.f. piping and the air-heaters. For the boiler drums, and for the steam piping, all the insulation material was pre-formed. On surfaces for temperatures up to 500 deg. F., 85 per cent. magnesia materials were used, while on surfaces for 1,000 deg. F. and above, "Dextramite" high-temperature material was first applied, and then a layer of 85 per cent. magnesia material. The h.p. steam and feed piping were insulated with composite Dextramite and magnesia radiused and bevelled slabs, and finished with ½ in. hard-setting cement and calico, sized on and aluminium painted magnesia or magnesia slabs were used for insulation of the fan casings, ducting, precipitator casings, etc.

Ash and dust-handling plant

In the completed station, up to 200 tons of furnace ash and 1,300 tons of fly-ash will be handled daily. The pneumatic fly-ash extraction plant, the hydraulic fly-ash disposal plant and hydraulic furnace-ash-handling plant, were all supplied by John Thompson Industrial Constructions Limited. The plant handling the furnace-ash is of the intermittently-operated, high-velocity, recirculating water-sluicing type, and is designed to remove the accumulation of furnace ash from the first three boiler units, but is capable of extension to serve the two further boiler units, Nos. 3 and 4. The ash is collected in hoppers of standard refractory-lined type, equipped with quenching water sprays to ensure maximum life both of the refractory lining and the cast-iron hearth material. Each hopper has five extraction chambers and hearths, ash being removed from each hearth consecutively, and conveyed through the sluiceway system by means of high velocity jets of water. The ash/water mixture is deposited into either of two grabbing sumps, the selection being made by the operation of a lifting sluice liner located adjacent to No. 1 ash sump. The pneumatic fly-ash disposal plant is designed to

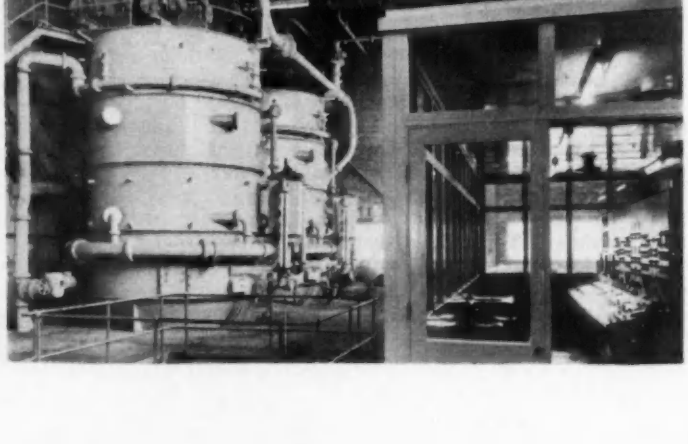


Fig. 8. Ash disposal plant ash/water mixers, and also ash plant control panels together with mimic diagram of plant. Remote push-button selection and sequence interlock is provided.

remove fly-ash from the hoppers of the economisers, air-heaters, mechanical collectors, precipitators and chimney associated with boilers Nos. 1, 2 and 3, and to convey it to the main fly-ash storage bunkers located above the ash pump house to the east of the precipitators.

From the main storage-bunkers, the fly ash is pumped to disposal areas. The fly-ash extraction plant is sectionalised, each section associated with an individual boiler, and it comprises airflow conveyors that enable the fly-ash collected in the hoppers to be transferred to the surge hopper associated with the Kennedy Van Saun automatic pneumatic transport pump. The chimney hopper is emptied of fly-ash directly to the No. 1 main storage-bunker by means of a 5-ton/hr. jet feeder connected to the hopper outlet. The Kennedy Van Saun automatic pneumatic transport pump has an hourly rating of 40 tons of fly-ash, and operates with filling and emptying cycle which is continuous throughout the pump's operating period, which is approximately six hours. This pump received fly-ash from the surge hopper positioned above it. After the automatic pneumatic transport pump has received its load of fly ash, valves are automatically closed, then compressed air is fed to the pump and the contents discharged to the main fly-ash storage bunkers. This cycle repeats itself.

The hydraulic fly-ash disposal plant takes fly-ash from either of two main dust-storage bunkers, which are located within the ash-plant house, passed through hydraulic vortex mixers and then pumped as a slurry by disposal pumps of special design through either of two discharge lines to the disposal point at Longannet, about three miles downstream. An initial pilot pond has been constructed in this area at a distance of approximately 12,500 ft. from the station, but the plant has been designed for pumping to the extreme end of the disposal area which would increase the length of each line to 17,330 ft. The plant differs from the conventional type of dust disposal pumping installation in that emphasis has been placed on achieving the maximum economy as expressed in power consumed per ton mile of dust handled. At the normal handling rate, the total pumping time, when handling slurry for the disposal, of the estimated 705 tons of fly-ash from the first three boilers is just under four hours. To this must be added a period of time for the starting up and closing down of the plant, together with the time of one hour for purging after completion of slurry pumping, giving a daily plant operating time of six hours. The extension plant serving two future boilers would run simultaneously with the present plant which will give a combined disposal rate of 380 tons of dust per hour. For driving the centrifugal ash-pumps where it is advantageous to run the pumps at the optimum speed for any particular condition, size-26 scoop-control fluid couplings, supplied by Fluidrive Engineering Co. Ltd., are incorporated. These couplings give variable-speed regulation from 940 r.p.m. down to 500 r.p.m., the S.C. motors being rated at 185 h.p. Control of the fly-ash handling plant is effected from panels equipped with mimic diagrams and remote push-button selection with sequence interlock. The disposal site, which covers nearly 280 acres, will eventually be reclaimed from the foreshore of the River Forth, and made available for agricultural purposes.

Turbo-alternators

The first three turbo-alternators, which were supplied by C. A. Parsons & Co. Ltd., are 120-MW impulse-reaction, 3,000 r.p.m. machines designed for steam conditions at the turbine stop valve of 1,500 lb./sq. in. and 1,000 deg. F. The turbines are three-cylinder, three-exhaust units, and the high-pressure cylinder is reversed, to minimise thrust problems. The shafts are solidly-coupled with only one thrust bearing. After expanding through the high-pressure turbine, the steam is reheated and enters the intermediate-pressure cylinder again at 1,000 deg. F. The intermediate-pressure cylinder incorporates low-pressure blading for one-third of the steam-flow, and the remainder of the steam is expended in a double-flow low-pressure turbine. The condensers are designed for 28-9 in. Hg. vacuum on normal conditions. Arrangements are made to extract steam from the machines at six tap off points to heat the feed-water to a temperature of 435 deg. F.

The exhaust steam is dealt with by a twin-shell condenser having a total cooling surface of 70,000 sq. ft. and using cooling-water at the rate of 60,000 g.p.m. One shell is coupled to the low-pressure exhaust on the i.p. turbine and to the adjacent l.p. exhaust, and deals with two-thirds of the steam, whilst the other shell is coupled to the remaining second l.p. exhaust and deals with the remaining steam. From the condensers, the condensate is delivered by extraction pumps through two low-

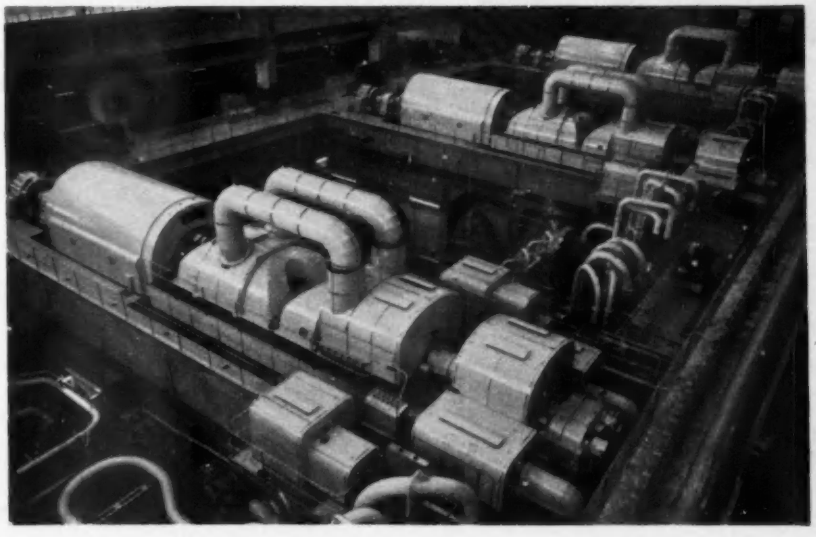


Fig. 9. The first three turbo-alternator sets are of 120-MW capacity, and together with the condensing and feed-heating plant, were supplied by C. A. Parsons & Co. Ltd.

pressure heaters to a high-level deaerator. In the case of No. 1 unit, before entering the three high-pressure heaters, booster feed-pumps raise the pressure of the condensate to 550 lb./sq. in. and after leaving the high-pressure heaters the feed water at 435 deg. F. is raised to a pressure of 1,950 lb./sq. in. by the main boiler feed pumps. Nos. 2 and 3 units are provided with full head feed pumps positioned before the high-pressure heaters in place of the split pumping arrangement.

The three booster feed-pumps and the three main boiler feed-pumps for No. 1 set were supplied by Mather & Platt Limited. The booster pumps are 8 in./10 in. four-chamber HSS Plurovane units each delivering 482,500 lb./hr. of feedwater at 555 lb./sq. in., and 260 deg. F. Generated head is 1,255 sq. ft. They are driven at a speed of 3,000/2,944 r.p.m. by Mather & Platt two-pole double squirrel-cage induction motors of 415 b.h.p. working from three-phase, 50 c/s, 6,600 V supply. The three high-pressure main feed-pumps are 6 in./7 in. Plurovane units of the barrel-casing type. Each delivers 482,500 lb./hr. of feedwater at 1,965 lb./sq. in. and 435 deg. F., and is driven at 3,000/2,975 r.p.m. by Mather & Platt two-pole solid s/c rotor induction motors of 1,300 b.h.p.

The three feed-pumps for each of Nos. 2 and 3 sets were supplied by The Harland Engineering Co. Ltd. Each of the six pumps is a 10-stage Harland "Spiroglide" unit supplying 485,000 lb./hr. of feedwater at 260 deg. F. (discharge pressure 2,005 lb./sq. in.). Each pump is driven by a Harland s/c motor rated at 1,650 b.h.p., 6,600 V, 2,970 r.p.m., three-phase, 50 c/s. There are no booster pumps associated with Nos. 2 and 3 sets.

The alternators have a rating of 120-MW at 0.85 p.f., 3,000 r.p.m., generating at 13,800 V and are cooled by means of hydrogen at a pressure of 15 lb./sq. in., and the gas is cooled by distilled water in light exchangers built in the stator casing. Excitation is provided by a main and pilot exciter unit driven from the generator rotor through reduction gearing at 1,000 r.p.m. Ventilation of the exciters is by means of filtered air circulated through the exciters by a fan mounted on the high-speed pinion shaft of the gearing.

The 200-MW generators (Nos. 4 and 5) will be G.E.C. four-cylinder, four-exhaust impulse sets. The turbine stop-valve conditions will be 2,350 lb./sq. in., 1,050 deg. F. and the reheat inlet temperature will be 1,000 deg. F. The flow in the high-pressure turbine will be reversed and the shafts will be solidly coupled with only one thrust bearing. After the steam leaves the intermediate-pressure cylinder it will pass into two double-flow low-pressure turbines exhausting to twin condensers. A seven-stage feed heating plant will be provided and the feed pumps will be of the full-head duty type installed before the high-pressure feed heaters. The generators will be cooled by hydrogen at 50 lb./sq. in. and, in addition, the stator conductors will be water-cooled.

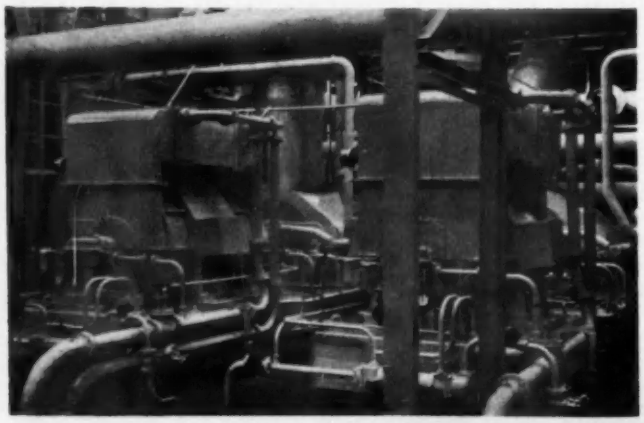


Fig. 10 (above). The six 485,000 lb./hr. capacity main feed-pumps for Nos. 2 and 3 sets were supplied by The Harland Engineering Co. Ltd. There are no booster pumps for these two sets.

Circulating-water system

Water for condenser cooling purposes is drawn from and returned to, the River Forth. As the river is tidal, complications arise in that the heated water from the outfall must flow past the intake for part of each day, no matter where the intake is situated. To determine the best arrangement tests were carried out on a specially-constructed model of the river, and it was found that, by using a long stretch and the full width of the river,

Fig. 11 (right). Water is conveyed to the c.w. pump suction-chamber via six 38 ft. dia. rotating drum-type screens of 70,000 g.p.m. capacity, and supplied by James Blakeborough & Sons Ltd.

a satisfactorily low temperature rise could be obtained at the intake during periods of slack water and low tide. The intake headworks were, therefore, situated some 500 ft. out in the river at the downstream end of the site where there is deep water reasonably close to the bank. This enables the colder water on the bed of the river to be drawn into the circulating water system when the heated discharge is flowing downstream on the river surface. The outfall is 2,700 ft. above the intake and angled upstream. The intake is provided with suitable fixed screens, and triple square section underground culverts convey the water to the c.w. pump suction chamber via six 38 ft. dia. rotating drum type screens of 70,000 g.p.m. capacity and supplied by James Blakeborough & Sons Ltd. The c.w. pump house will incorporate six 65,000 g.p.m. vertical-spindle centrifugal pumps, four of which have been supplied initially by Drysdale & Co. Ltd.

Fig. 13. The electrical control room is located centrally in the turbine house switchgear annex.

Fig. 12. H.M. the Queen, who was accompanied by the station superintendent, Mr. G. Nicholson, during her tour of the station, is here seen in the turbine house.

Water treatment plant

The raw water for boiler feed requirements is drawn from Glendevon reservoir. It is a typical moorland water, " thin " and containing a large quantity of organic matter. The plant to make this water suitable for make-up requirements was designed and manufactured by The Permutit Co. Ltd., to satisfy a demand for 174,000 gal. of highly-purified water per 16-hour operational day. The treatment consists of clarification, followed by degassing and iron removal, then finally removal of dissolved solids by mixed-bed ion exchange. Firstly, the raw water is dosed with alum by means of two Permutit " E "-type chemical pumps, and then passes into a contact tank where chemical action coagulates the colour and suspended matter. After settling, the partially-clarified water passes through three Permutit pressure-type sand filters which remove any remaining suspended matter ; the flow through these filters being 11,600 g.p.h. From the filters the water flows down through a degasser tower which is filled with porcelain rings, the water in descending over these rings being subjected to a stream of air being pumped upwards.

Following iron removal, the water passes to two mixed bed " Deminrolit " ion exchange units for final treatment. Each of the units contains a bed of intimately-mixed cation and anion exchange resins (" Zeo-Karb 225 " and " De-Acidite " FF respectively). Water passing through these units thus comes into contact with beads of cation and anion material alternately, thus being subjected to an almost infinite number of demineralising stages. This repeated re-treatment produces a highly-purified boiler feed make-up water with a total dissolved solids content of less than 1.0 p.p.m., at a flow rate of 11,000 g.p.h. During normal operation, the two mixed-bed ion exchange units work in parallel. They are, however, designed so that when regeneration of one unit is necessary, the other unit can maintain the full flow of 11,000 g.p.h. by itself. Regeneration is carried out after each unit has treated 87,000 gal. of water.

The cooling water for the condensers is taken from the River Forth, and thus steps must be taken to prevent mussel and marine fouling as well as slime formation within the condensers. This is achieved by the intermittent application of chlorine at the circulating-water intake. The chlorination plant, supplied by Wallace & Tiernan Limited, consists of two Master chlorinators each having a capacity of 6,000 lb. of chlorine per day, operated from a programme controller set to give the required length and frequency of treatment automatically. Provision has been made for installing a third chlorinator and any one of the machines will be able to act as standby to either of the other two.

Experimental Boiler for Fuel Oil Combustion Research

WE were recently invited to visit the Kent Oil Refinery of The British Petroleum Co. Ltd., on the Isle of Grain. The primary purpose of the visit was to see an experimental oil-fired boiler which has recently been installed in a new combustion research laboratory on a site adjoining the main refinery. The main function of this new boiler is to provide facilities for studying problems of high and low temperature corrosion in oil-fired boilers, and at the same time to assist in investigations concerning the problem of air pollution from flue gases. Research is also being carried out into the problems associated with the conversion of existing boilers from solid-fuel firing to oil-firing.

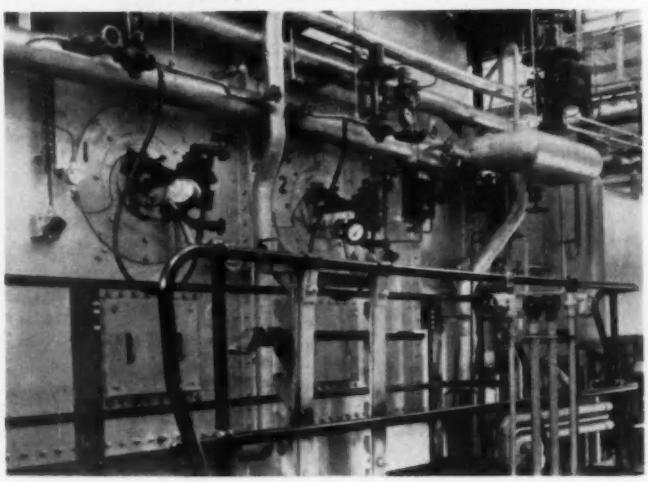
For several years now The British Petroleum Company's research organisation has been working on these problems. The initial research was carried out at the company's research centre at Sunbury-on-Thames, and subsequent field trials, on full-scale boilers made available for the purpose by various industrial concerns both in the United Kingdom and in Europe. The results of this work, in which other research bodies and plant manufacturers frequently collaborated, were reported in a paper read to the 1959 World Petroleum Congress. These investigations have contributed to the knowledge necessary to effect improvements in design of superheaters and their supports, and after extensive study of low-temperature corrosion problems, a method of controlling the effects of acid on heat-exchangers has been evolved—ammonia gas being injected into the low-temperature zone of the flue gases. Also, in order to reduce or eliminate the emission of smuts and chimney corrosion, the technique of shielding metal chimneys with aluminium has been developed.

In all the research work hitherto carried out, extremely valuable results have been achieved; however, it had by now become apparent that complementary to these trials, experiments on a full-scale basis were necessary with a boiler installation under the complete control of the research team. The company, therefore, agreed to install the experimental boiler in the Isle of Grain establishment, thus enabling purified feedwater and fuel-oil of the required specification to be drawn from the refinery as required.

The boiler, supplied by Babcock & Wilcox Limited, has an evaporative capacity of 20,000 lb./hr. of steam at a pressure of 350 lb./sq. in. and with a final steam temperature of 1,200 deg. F. It is of a specially-designed bi-drum, water-tube, natural circulation tupe, with an integral furnace, and is provided with an economiser, two air-heaters and the means for recirculating the flue gases. High quality distillate from the main refinery power station high-pressure evaporating plant is used for the boiler feedwater. The steam produced by the boiler is passed through pressure-reducing and desuperheating plant, after which it is suitable to be employed on process work within the refinery. The maximum steam output from the desuperheater is approximately 30,000 lb./hr. at a pressure of 175 lb./sq. in. g. and a temperature of 480 deg. F.

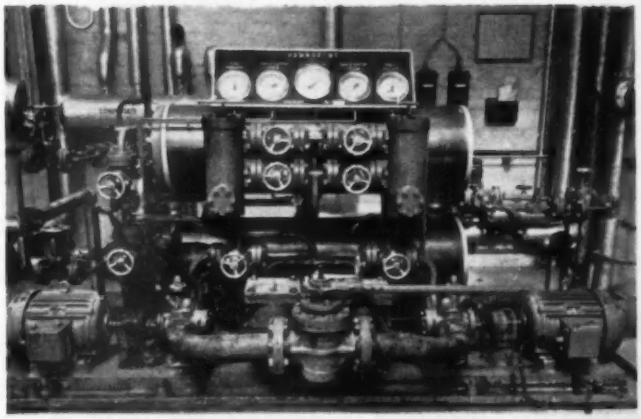
The combustion chamber is water-cooled on the roof and side walls, and leads directly into three parallel horizontal gas-passes which are separated from each other by water-cooled refractory screen walls. The centre-pass comprises the generation system, whilst the two outer passes contain the superheaters; which are of pendant construction in one pass, and self-draining horizontal tubes in the other. Each superheater is arranged with the primary section in counter-flow, the secondary section in parallel flow, and each one is designed to deal with half the quantity of steam generated. The tubes are of mild-steel and 18/12 austenitic-steel in the primary and secondary systems respectively, and are 1½ in o.d. on a 3-in. pitch. The gas flow is through the centre generating-bank and the superheater passes, which are controlled by separate outlet dampers, thence into a common rear boiler-bank system of horizontal tube construction. Problems of support for the boiler pressure parts were mainly overcome by suspending them from the upper boiler framing. The boiler has a guaranteed gross thermal efficiency of 88 per cent.

The economiser supplied by E. Green & Son Ltd. is of the cast-iron gilled-tube Premier Diamond Type 25,



Front view of the Babcock 20,000 lb./hr. boiler showing location of the oil burners.

and is arranged in counter-flow in two tiers. It is supplied with water-washing facilities and is fitted with dampers for up to 100 per cent. gas by-pass. The air-heater is in two parallel sections, one of cast-iron and arranged in two tiers was supplied by E. Green & Son Ltd., and the other, of tubular steel type, also in two tiers, supplied by Babcock & Wilcox Limited. In order that information can be obtained on fouling and corrosion on each type of air-heater, each section has been designed to deal with 50 per cent. of the gas from the economiser outlet, and each can be operated in either counter-flow or parallel flow on the air side, while up to 100 per cent. by-pass of the gas is obtainable by the operation of dampers. Water-washing equipment and facilities for collecting wash-water samples are built into both sections. The boiler outlet gas temperature is 217 deg. F.



(Left). The fuel oil heating and pumping unit and associated equipment was supplied by Hamworthy Engineering Limited.

Hamworthy Engineering Limited supplied the oil firing equipment. Two 5,000-gallon fuel oil service tanks, one 750,000-gallon tank and one 150,000-gallon tank have been installed, making it possible to carry out extended test runs on uniform fuel-oil blends. The oil pipelines, which are steam-traced, enable fuel of up to 6,000 sec. Redwood No. 1 at 100 deg. F. to be delivered to the burners at pressures of up to 500 lb./sq. in. The pumping and heating unit comprises two electrically-driven positive-displacement pumps, two steam/oil heaters and strainers, all mounted on one bedplate and supplies two pressure-jet burners, fitted with Lucas swirl-plates, which are suitable for operation with forced-draught. The air-registers are fitted with primary and secondary air ports which are controlled by adjustable vanes. The refractory front wall of the furnace is free from tubes, thus making it possible to fit spill-type, steam-jet, low-pressure or high-pressure air-atomising systems. A new type of insulation has been used for the main fuel tanks; this includes studs which are welded to the tank, in order to carry fibre-glass insulation, which is externally clad with corrugated aluminium.

The forced and induced-draught plant was supplied by Davidson & Co. Ltd. The Sirrocco fans are motor driven, the induced-draught fan being driven through a fluid coupling, supplied by Fluidrive Engineering Co. Ltd. This coupling is a size 18 type SCR.4 unit rated for 25 h.p. at 970 r.p.m. It has a full-load slip of about $2\frac{3}{4}$ per cent. and will, therefore, give infinitely variable speed control from approximately 940 r.p.m. down to 200 r.p.m. on the output shaft. In order that the boiler may operate under natural-draught conditions, a by-pass system is arranged on the i.d. fan. Also supplied is a gas-recycling fan which can recirculate up to 60 per cent. of the flue-gas and deliver it to one of three positions; to the burners in conjunction with the combustion air, into the furnace above the burners, or into the gas stream immediately before the super-heaters. The self-supporting chimney is of riveted-steel construction, 150 ft. high, and is lined throughout with acid-resistant fire-brick. Provision has been made for the possible future installation of an electrostatic precipitator adjacent to the chimney.

The control equipment, which is of pneumatic type, has been supplied by Bailey Meters & Controls Limited. In addition to the normal instruments used in boiler operation, there is a fully-automatic combustion control

(Below). View alongside of boiler showing research instrument panel and also boiler control panel.

system which is designed to enable the boiler to be maintained under constant steam-load conditions with any constant combustion condition. The furnace pressure can be kept constant by the use of a furnace-draught controller, while the superheater temperature is controlled from the fuel/air ratio meter. A final control can be obtained on the damper setting by means of a temperature recorder/controller. The control system incorporates various safety locks which come into operation in the event of a failure in the air supply to the automatic control system. The superheater dampers are also designed to close if the steam temperature becomes too high. A newly-developed acoustic type of flame-failure equipment is provided, and a complete boiler safety interlock system has also been supplied.

The duplicate boiler feed pumps, supplied by G. & J. Weir Limited, are of the vertical, direct-acting type, each capable of delivering 30,000 lb./hr. of boiler feedwater. In addition, by means of a high-pressure feedwater heater, the temperature of the feedwater can be raised from below 200 deg. F. to 330 deg. F. Hopkinsons Limited supplied the pressure-reducing and desuperheating equipment which is manufactured from austenitic steel. The temperature of the water required for desuperheating purposes can be raised from 60 deg. F. to 300 deg. F. by means of a spray water heater with a capacity of 10,000 lb./hr.

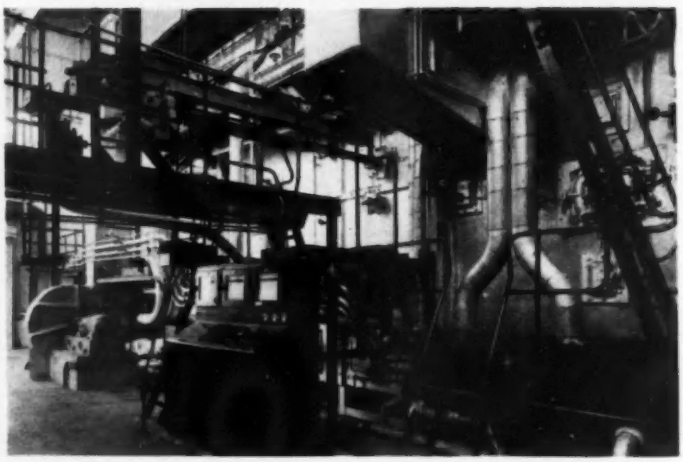
In order to carry out research work on the boiler, 25 probe-holes have been provided in which specialised instruments can be inserted. Generally of 6-in. dia., many of the probe holes are located in the numerous access doors provided on the boiler plant. Included amongst the probes and research instruments are the following:—

For high-temperature conditions

Completely water-cooled pilot-static tube.
Water-cooled suction pyrometers.
Water-cooled gas and solid sampling probe similar to those used by the International Flame Foundation at Ijmuiden, Holland.
Total radiation and optical pyrometers.

For low-temperature conditions

B.C.U.R.A. type dew-point probes.



Side view of boiler showing research instrument panel and the Davidson gas re-circulating fan.

B.C.U.R.A. type hemispherical specimen corrosion probes.
Weight loss corrosion probes as developed by the Shell Petroleum Company.

To serve these special instruments, a comprehensive supply system is available at ground level and at various positions on the galleries.

In addition to the normal boiler instrument panel, a separate research temperature-survey panel is provided which incorporates two multi-point millivoltmeter recorders covering a wide range of sensing and printing speeds, and a fast response single-point millivoltmeter recorder. The input terminal on any of the above instruments can be connected to any one of 15 stations around the boiler plant. Many of the instrument probes have been designed to completely traverse across the boiler unit from one side only. Unusually long probes have resulted, and to overcome the difficult handling problem involved, a system of probe-handling runways has been provided. Facilities for collecting solids in the gas stream will be available, the techniques having been specially developed at B.P.'s Research Centre, at Sunbury.

Normal gas-analysis facilities are available and SO_2 and SO_3 can be measured chemically and manually, while in addition, SO_3 can also be measured by an automatic SO_3 recorder. Sections of superheater tubes and corrosion specimens will be electrolytically descaled by the use of molten caustic soda at the Sunbury establishment.

The boiler house is a simple portal-framed building of insulated asbestos-cement sheeting. Adjacent to the house is a small self-contained workshop and general purpose laboratory which contains a high-temperature electric furnace capable of reaching 1,400 deg. C. This is used for the calibration of radiation pyrometers, etc. Normal fuel analyses will be carried out at the main refinery laboratory; more involved analyses, however, will be carried out at Sunbury.

The installation of this plant which, as far as is known, is the only unit of its kind installed by an oil company solely for the purpose of applicational research, will obviously enable a wide range of research investigations to be undertaken in connection with the problems referred to at the beginning of these notes and the BP Company believes that each investigational programme will have to be very carefully considered. In order that the maximum amount of information can be obtained, it is thought to be essential for each series of experiments to be designed on a statistical basis. The initial experiments already being carried out have been made in an attempt to determine trends likely to be expected in measurements made in relation to the period of time which the boiler has been in service. It is expected that useful and interesting information will be forthcoming during these tests concerning the influence of boiler life on various operating variables concerned on such a plant.

Central Electricity Generating Board

Annual Report

THE annual report of the Central Electricity Generating Board for the year ended March 31st, 1960, was published recently, and shows that a net surplus of £5,446,928 was achieved during the year. This is approximately equal to half the surplus which was achieved during the previous year. Although sales of electricity showed an increase, this was more than balanced by expenditure on generation and transmission.

A record maximum demand of 23,089-MW at normal frequency and full voltage was experienced on January 14th, 1960, but this was met by a high availability of generating plant during the winter months with an average of 92.6 per cent. in December and January. Increased thermal efficiency resulted in a saving of £3.3 million on fuel costs over the year, and average works costs per unit sent out have been cut from 0.645d. in the previous year to 0.604d. A total income of £281 million was received from the sale of electricity, representing an increase of 10 per cent. over the period 1958-59. Over 52 per cent. of the £376 million total expenditure was spent on fuel, and 28 per cent. on capital charges, depreciation and interest on capital. Of the £215 million expended on plant and equipment, £118 million was spent on conventional power stations, £58 million on nuclear stations (excluding £6.5 million on initial nuclear fuel) and £35 million on extensions to the national grid.

Savings resulting from the use of cheaper fuels in power station boilers have brought about a reduction of 4 per cent. in the average price per unit charged to the Area Boards who distribute practically the whole of the C.E.G.B.'s output. To enable the Board to increase the sale of units without a corresponding increasing in maximum demand, a new scheme was introduced during the year under which specialised industries with loads over 25-MW are quoted special terms. These special terms apply only to industries which by arrangement can interrupt their processes, and thus reduce their consumption on request. The Board also announced its intention during the year of continuing the tariff, introduced during 1959-60 for 1960-61, thus making a further contribution to price stability.

Power generation and transmission

The total nett output capacity of the Board's power stations was increased during the year by 2,219-MW after deducting the output (316-MW) of obsolete plant, taken out of commission. This represents an increase for the year of 9.1 per cent. to the total output capacity of the Board's stations. Included in these figures are the outputs from six new stations, viz., Aberthaw, Belvedere, Drakelow "B," Elland, High Marnham, and Northfleet, and extensions to 12 existing installations. With the inclusion of High Marnham, the first 200-MW set and the first 1,400,000 lb./hr. boiler plant were added to the system, thus continuing the development of larger and higher performance generating plant. During the year, overall thermal efficiency increased from 26.1 to 26.53 per cent. The 20 most efficient stations, which contain over 20 per cent. of the Board's output capacity, and supply 31.7 per cent. of total output, reached an average of 30.95 per cent. and were led by Blyth "A" which had a thermal efficiency of 34.31 per cent. At Spondon "H" power station, a steam supply was connected to an industrial concern from the Board's back-pressure sets, bringing the number of such consumers up to 47, and the number of stations supplying steam to 23. These stations have supplied 33 million therms during the year. Of the 8.5 million tons of ash produced during the period under review, about 9.5 per cent. was sold for use in building and civil engineering work.

Dealing with nuclear plant, in addition to the five nuclear stations at present being built at Berkeley, Bradwell, Hinkley Point, Trawsfynydd and Dungeness, the Minister of Power has also given consent to the building of a sixth station at Sizewell in Suffolk, and his decision is awaited concerning another site at Oldbury-on-Severn.

Development of generating plant

During the year under review orders were placed for two units of 300-MW, two of 350-MW, and one of 550-MW output. Each of these will be designed for steam conditions of 2,300 lb./sq. in. and 1,050 deg. F. reheating to 1,050 deg. F. The four smaller units will incorporate a single-shaft turbo-generator, whilst the 550-MW unit at Thorpe Marsh comprises a two-line turbo-generator. Investigations were made into the possibility of achieving still further economies by using larger single-line units, and it was agreed that the installation of a 500-MW unit of this type in 1965 was practicable, and likely to provide profitable advantages. Steam conditions would be similar to those applying in the case of the 350-MW units, therefore coal consumption per unit of electricity generated would be almost the same. The increased rating, however, should result in further savings in capital cost. Steel and other materials are saved by the installation of larger generating units. A 30-MW turbo-generator, for example, weighs about 8.3 tons/MW, but a 350-MW one will weigh approximately 3.1 tons/MW. The volume of station buildings has been reduced from 39.4 cu. ft./kW in a typical 180-MW station (with 30-MW sets), to 22.1 cu. ft. in a 1,100-MW station (with 550-MW units) now under construction. The time for the actual construction of power stations has also been reduced. As a result of these and other improvements, conventional stations are being built today at an average cost in the region of £50 per kW of installed capacity, which, despite substantial rises in costs of materials and labour, is no greater than the corresponding figure in 1948. Still lower average costs are estimated for stations now

being planned—of the order of £40 to £45 per kW. Two new units, for which authorisation was given during the year will operate above the supercritical steam pressure of 3,206 lb./sq. in. The units in question will be at Drakelow "C" station, and will each have a generating capacity of 375-MW. One is scheduled to be commissioned in 1965 and the other in 1966. The boilers will be designed to provide steam at 3,500 lb./sq. in. and 1,100 deg. F., reheating to 1,050 deg. F. The savings in steel and other materials in a supercritical unit are expected to reduce the weight considerably, but the reduced fuel consumption resulting from improved thermal efficiency is expected to be offset by the increased capital cost resulting from the use of more expensive materials in construction. The future of supercritical steam conditions, therefore, depends on the development of materials and techniques enabling costs of plant to be reduced. Sir Christopher Hinton, chairman of the Board, emphasised that it was important for manufacturers to gain experience of building such plant.

It will be appreciated that it is essential to have a very high standard of purity in the boiler feedwater in a supercritical unit, and with this object in view, a research programme has been put in hand. Research has also been started into the selection and fabrication of special steels necessary with the use of steam at 1,100 deg. F. All new conventional steam power plant is now being designed to enable rapid starting-up to be accomplished following overnight or weekend shut-down. With this feature in mind, starting and loading tests have been arranged in a series of selected 100-MW or greater capacity units, the object being to determine the minimum time in which these operations can be carried out within the prescribed limits of temperature differentials and rates of change. One test already carried out, was at Ferrybridge "B" power station and it was found that the reheat units there were sufficiently flexible to accept the specified rates of loading. Considerable information was obtained here and it is expected this will be of assistance in the operation of the station and also in the design of future installations.

Collaboration has been maintained over the year between the Board and the boiler manufacturers into problems associated with pulverised-coal mills and dust-extracting plant. Mills with grinding capacities of up to 40-50 tons/hr. have been tested, and it is hoped that they will reduce maintenance costs and auxiliary power consumption in the larger boiler plants; savings in auxiliary power consumption are also expected to result from investigations which have been made into the best combination of mechanical dust-extractors and electrostatic precipitators for cleaning the grit-laden flue-gases.

With reference to turbo-alternator sets for use with new conventional steam plant, the steam is now reheated after its partial expansion in the turbine, resulting in a reduction in the amount of water produced by condensation of the steam on turbine blading. Due to the high peripheral speed of the low-pressure blading on modern large turbines, it is becoming increasingly necessary to investigate damage to blading caused by water erosion; and for this reason a research programme has been started. In the case of turbines for use in nuclear plants, considerably more condensation takes place, and methods of separating the moisture from the steam at an intermediate steam stage are being developed.

In the Board's 1958-59 report, reference was made to the proposed use of concrete for the volutes of large circulating-water pumps. An order has now been placed for the first pump of this type which will have a capacity of 147,500 gal./min. Even larger pumps than this will be required for power stations as yet in the project stage, and provisional enquiries have been made for pumps of 300,000 gal./min. capacity, and also for low-head reservoir impounding pumps of 900,000 gal./min. capacity.

Research programme

Expansion of the Board's research activities has continued throughout the year. The combined revenue and capital expenditure totalled £2 million as against £1.1 million in the previous year. Sir Christopher Hinton emphasised the importance of research work and development; the number of staff employed on research work has been trebled, and the target was to spend about £3.2 million per year. A "Pace" analogue computor has been put into service during the year and is employed mainly on nuclear energy calculations. An IBM 709 computor is also being used.

General investigations being carried out into the better use of pulverised fuel fly-ash, the extraction of dust from the flue-gases of coal-burning stations, and additives and combustion conditions for reducing the acid content of flue gases in oil-burning stations. Research has also been carried out aimed at improving and further developing the existing grid system. Research continued on transmission at 380-kV, and work started on the design of a 500-kV system using multiple-bundle conductor lines. The scope and effectiveness of the research and development work in both nuclear and conventional fields is essential for the Board's long-term economy in capital projects, and it is for this reason that it is receiving the highest priority.

INTERNATIONAL COMBUSTION (HOLDINGS) LIMITED, AND SIMON-CARVES LIMITED

For some years past, the above-mentioned two companies have enjoyed close technical liaison, particularly regarding the technique of thermal power plant design and manufacture. Due to the interests of both companies being complementary in many other industries, it has been possible to develop inter-company trading, to a very substantial extent and this has proved to be of great benefit to both parties. In the light of this knowledge, the directors of both companies have considered the possibility of even closer association and have decided that a measure of integration should be effected resulting in greater overall efficiency in operation and wider fields of application of the extensive experience inherent in both organisations. At the same time the individual identity of both organisations will be preserved and no alteration to existing commitments and associations of either company is envisaged. This integration of effort applies essentially to the technical fields, and it is not intended that any merging of capital or financial resources should take place. At the same time, such joint financial resources would be available for any large industrial undertakings, particularly overseas, requiring substantial capital outlay and extended credit facilities.

Progress at Hunterston

During a recent visit to the 300-MW Hunterston nuclear power station of the South of Scotland Electricity Board, we were able to see the extent of the constructional progress that has been made since full working was resumed on the site last January. The station is now about two-thirds complete—some details of the present state of the project being given in the following notes

AS will be seen from the illustrations accompanying these notes, the major portion of the civil engineering work on the two reactor structures, and the turbine house for Hunterston nuclear power station has now been completed. The station, which is situated on the Ayrshire coast, some 35 miles south-west of Glasgow, is being built for the South of Scotland Electricity Board, by the G.E.C./Simon-Carves Atomic Energy Group. It is anticipated that the first reactor will be in commission before the end of 1962, and the second during the autumn of 1963. Now that the last sections of the concrete biological shield of the first reactor have been placed, a start has been made on the building of the structure to house the service machine, which has already been assembled for testing at the G.E.C., Erith Works. Emphasis on construction has now moved from civil engineering to mechanical engineering, with the fabrication and installation of the pressure-vessels, steam-raising units, mechanical and electrical plant.

Since work restarted in January of this year, production has been maintained at a satisfactory level. Inside the first reactor structure, for instance, the assembly of the 3 in. (76.2 mm.) thick, 70 ft. (21.34 m.) dia. pressure-vessel is complete, all courses having been placed and welded together, with the core support grid and inner heat shield located inside the vessel. The vessel is now being prepared for stress-relieving. The supporting skirt of the second reactor pressure-vessel has been fabricated *in situ* inside the biological shield, and the combined bottom head and support course, and No. 2 course, have been lifted into position. Elsewhere on the site, fabrication and assembly of the steam-raising units has been progressing; several of the 210-ton vessels having been stress-relieved and hydraulically tested, are now in the final stages of construction, which includes nuclear clean conditioning. The first steam-raising unit associated with the first reactor was accepted and lifted by the Goliath crane onto its plinth on September 15th, and preparations for tubing and gas-circulator installation are already under way. Sections of the clean-conditioned gas-ducting linking the reactor pressure-vessel with the steam-raising units have arrived on site. Externally, the 680-ft. long (208-m.) turbine house appears complete, although internally much work is still in progress. Three of the six condensers are installed, while the foundations for the turbo-generators are ready, awaiting the arrival of the sets, the first of which is due on site within the next few weeks. Further down the coast, to the south of the main part of the site, is the circulating-water pumphouse. This building is finished and much of the equipment, including pumps, motors, bandscreens, valves, filters, etc., is installed. The associated culverts

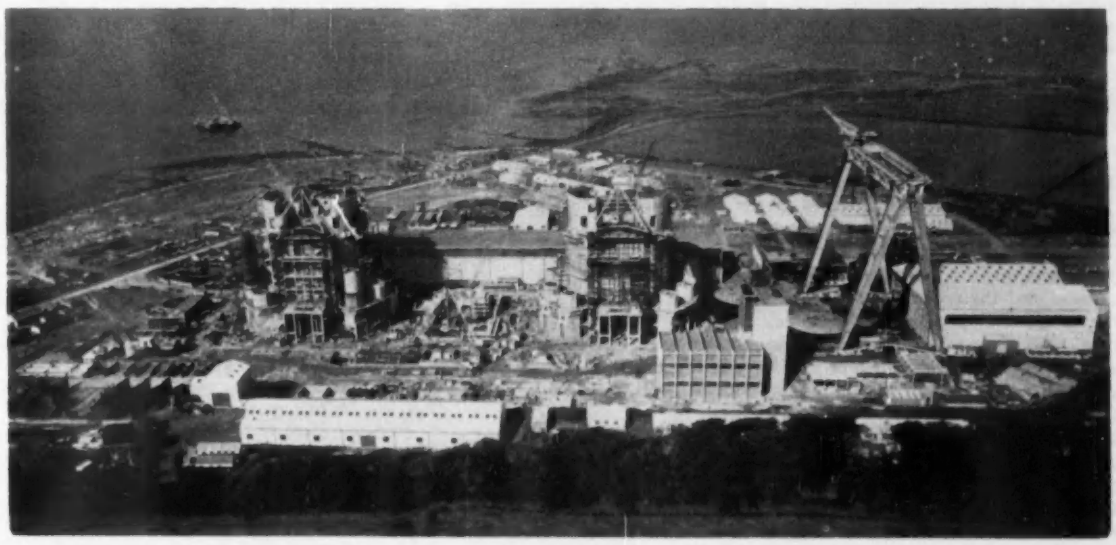


Fig. 1. Aerial view of Hunterston nuclear power station. On the left the first steam-raising unit of reactor "A" can be seen on its plinth. Reactor "B," under construction, can be seen in the centre, and in the foreground just to the right of reactor "B" is the charge-machine maintenance building.

and tunnels on the intake side of the circulating-water system have been completed. Start-up of the outfall pumps will be syphon assisted to maintain hydraulic head. On the outfall side, some 600 yd. (550 m.) further up the coast, the tunnels have been driven and are now being lined and the syphon seal is almost finished, thus bringing the end of civil work in this area in sight.

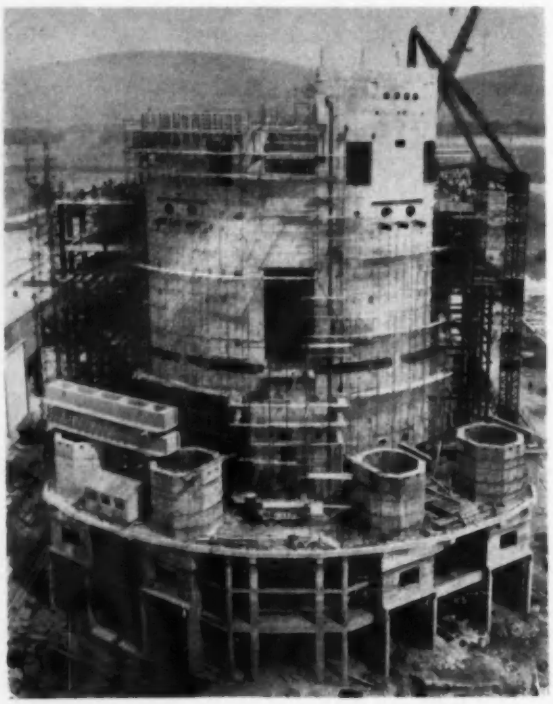


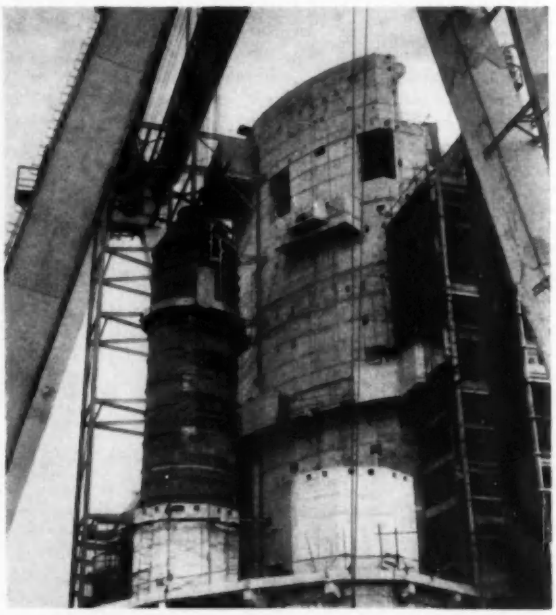
Fig. 2 (above). Reactor "B" with the plinths for four of the steam-raising units. Two of the concrete beams which will form part of the soffit of the roof biological shield are shown stacked ready for lifting into position.

Fig. 3 (right). Close-up view of the first steam-raising unit for reactor "A" installed on its plinth.

Reactor "A"

On the north and south sides of the now-completed concrete shield, the adjoining "reactor building" and "exit building" are being constructed. On the other two faces of the biological shield, the eight concrete plinths and their connecting floors are ready to receive the steam-raising units, one of which is already in position. All the seal oil pumps, oil-storage tanks and oil-coolers have been installed at the various levels in the reactor structure, and much of the concrete structure upon which the tracks of the service machine will be mounted has been built. The 450-ton machine will be situated at the 178 ft. 6 in. level (54.5 m.), above the biological-shield roof of the reactor, and will have longitudinal and cross-traverse facilities. A "rehearsal" shaft for the charge-machine is included in the reactor structure, and the civil engineering for this is finished. It will be able to test every function of the charge machine, and is expected to be used daily when the station is in operation. Other completed work associated with the charge machine includes the installation of the turntable tracks, roller path, cooling and shielding water-tanks, for the charge machine and the fitting of the massive exit shielding door. With the approach to completion of the circumferential welding between the various courses of the reactor pressure-vessel and the good progress on welding-in, and non-destructive testing of the charge nozzles and control rod nozzles, the time for stress-relief of the whole structure is approaching. Electrical resistance heating will be employed for this operation, which will then be followed by final installation work and a pneumatic pressure test; this test consists of subjecting the sphere to an internal air pressure of 253 lb./sq. in. and checking for leaks.

Laying of the graphite blocks will begin during the summer of 1961. The top inner surface of the pressure-vessel is to be cooled by diverting some of the incoming CO_2 coolant gas through a system of pipes suspended between the inner heat-shield and the pressure-vessel dome. These pipes, which are perforated on the upper surfaces to permit the escape of the coolant gas, are in the process of being erected. Closing-in of the reactor structure with precast-concrete units which form the soffit of the roof biological shield has begun. Six inverted double-webbed T-beams are being used for this purpose, and they span the aperture, being supported at each end on a 308-ton member. Some of these T-beams are being left out temporarily to facilitate access to the reactor, but infilling of the remaining members has already commenced. Clean conditioning of the gas-ducting, blowers and other plant directly in contact with the circulating cooling-gas is done partly on site, but mainly in the manufacturers' works. Sections of the clean conditioned ducting, parts of the first gas-circulator (impeller and diffuser) and the main gas-valves for reactor "A" are beginning to arrive on site and are being



erected. Temporary structures are also being built in the vicinity of the reactor for the installation of the gas-circulators and boiler tubing under nuclear "clean conditions." During the past few months, the first gas-circulator drive has been undergoing a test equivalent to about six months' continuous running time under load conditions and under simulated conditions of misalignment ($\frac{1}{2}$ in. displacement of fly-wheel), and this has been satisfactorily concluded. More recently, a shock load test has also been successfully carried out. Each gas-circulator will be situated in the base of a steam-raising unit so that it will handle gas at the lowest temperature. The circulator will be mounted vertically with the impeller and diffuser inside the shell, and the drive outside, in order to simplify the gas-sealing arrangements. A fly-wheel weighing about 7 tons, and direct-coupled to each circulator will provide enough kinetic energy to maintain gas-flow and pressure for about 30 sec., in the event of supply failure to the motor.

Reactor "B"

As already mentioned, the concreting of the 9-ft. thick shield has reached an advanced stage, permitting work to proceed on the fitting of the plate-work on the outer skirt walls and on the inner face of the walls of the biological shield. This plate work allows for expansion, and is spaced 2 in. away from the walls to form a region through which air is circulated to control the temperature of the biological shield.

Work on the pressure-vessel associated with this reactor is being carried out under cover within the special prefabrication area adjacent to the structure. The outer skirt has been fabricated *in situ* in the reactor vault, while the combined bottom head and support course was fabricated outside and lifted into position. Slotted gussets welded on the outside of the support course are used to locate it on the outer skirt. The 120 gussets which fit on the inside of the bottom head to carry the core support grid have already been welded into position. More recently, the second course has also been placed into position. The other courses of the pressure-vessel are all in various stages of manufacture. A start has also been made on fabricating the core support grid, and the inner heat shield. Profiting from reactor "A" experience, work is more than two months ahead of schedule. Although it is not possible to erect the biological shield roof, the two 308-ton members, and the six double-webbed T-beams which form the soffit have already been cast, and are stacked on the nearby plinths of the steam-raising units.

Steam-raising units

The shell of the first steam-raising unit has been internally cleaned and is in position on its plinth, ready for the erection of the main gas-ducts and installation of the internal tube banks. The shells of the other 15 steam-raising units, for both reactors, are in the process of assembly. Three of these have been stress-relieved at about 575 deg. C. and tested hydrostatically at a pressure of 253 lb./sq. in., and two are now being clean conditioned. Two more have been prepared for stress-relief. Further top and bottom head assemblies of the steam-raising units are being fabricated at the works at Stockport of Simon-Carves Limited, and several have been delivered to site.

There will be eight steam-raising units per reactor—the shell of each unit being 73 ft. 6 in. high and 19 ft. 6 in. dia. Each unit will include one high-pressure and one low-pressure boiler, with independent economiser, evaporator and superheater banks. The inlet gas temperature will be 755 deg. F. (401 deg. C.) and the outlet gas temperature 392 deg. F. (200 deg. C.). Outlet

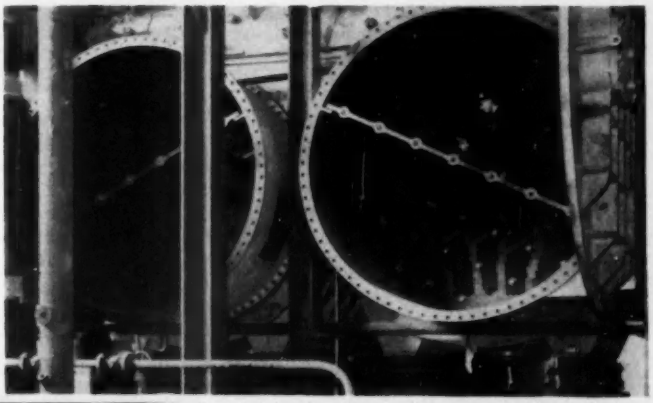


Fig. 5 (above). The condensers were all supplied by Hick, Hargreaves & Co. Ltd. Here are seen those for No. 1 turbo-alternator set, during the final stages of erection.

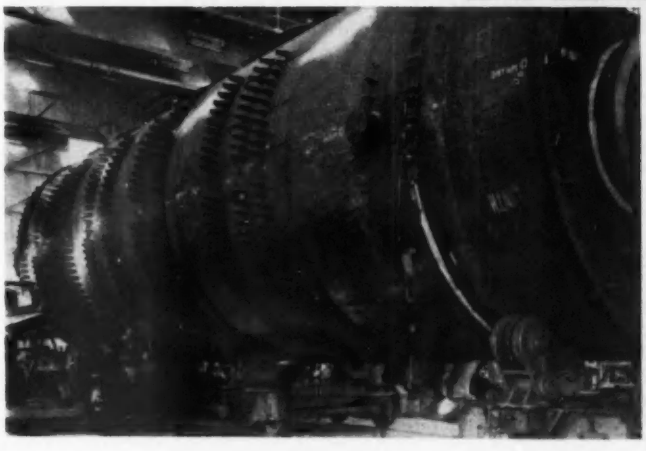


Fig. 4 (left). One of the fifteen 73 ft. 6 in. high by 19 ft. 6 in. dia. shells for the steam-raising units Shown in the site fabrication workshop. There are eight steam-raising units for each reactor.

steam conditions will be: High-pressure—152,400 lb./hr. at 578 lb./sq. in. and 725 deg. F. (385 deg. C.) and Low-pressure—75,500 lb./hr. at 147 lb./sq. in. at 658 deg. F. (363 deg. C.). The feed temperature at the economiser inlet will be 298 deg. F. (148 deg. C.).

Circulating-water works

The construction work for the circulating-water supply is probably the most advanced of all the work on the station. The circulating-water system is designed to meet a full load demand of 324,000 gal./min. The intake headwork and jetty are practically complete, and the lining of the twin intake tunnels and land shafts is finished, as is the main structure of the pumphouse, including the outer stonework facings. The penstocks and all eight band type screens inside the pump-house have been erected, together with four of the six main circulating-water pumps (each of 54,000 g.p.m. capacity) and three of their 800 h.p., 6.6-kV motors, and associated pipework and valves. The access galleries in the pump-house will be finally completed after the installation of the remaining pumps. To prevent fouling of the various culverts and pipework by marine organisms, the circulating-water system is provided with equipment which delivers chlorine solution to the intake headworks. The automatic dosing gear and pumps for this system have been installed in a room in the main pump-house. The drums of chlorine will be kept in a separate storage room, adjacent to the pumphouse loading bay, which is fitted with special ventilating equipment to ensure the safety of personnel. Work on the siphon seal, outfall shafts and on-shore outfall culverts is proceeding, while the junctions between the on-shore culverts and the off-shore 10-ft. dia. tunnels are practically complete. The construction of the outfall headworks, some 460-yd. off-shore, is well up to schedule.

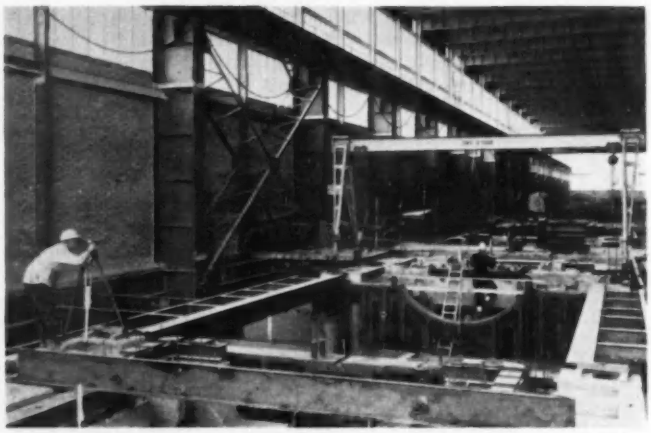


Fig. 6. Interior of turbine house with preparations being made for the installation of the mechanical and electrical plant.

Turbine house

The turbine house is approximately 700 ft. long and 130 ft. wide. It will contain six G.E.C. 60-MW turbo-alternator sets, each comprising a dual pressure turbine driving an alternator cooled by hydrogen at a pressure of 30 lb./sq. in. and incorporating direct-cooler rotor windings. The civil engineering on the interior of the turbine house is substantially complete. The foundation blocks for the six turbo-generators are in position, and delivery of the first two sets is being made this month. Reinforced-concrete blast-walls have been constructed to prevent accidental damage to the cabling which will eventually be run over the "pipe bridge" linking each reactor to the turbine house. The tank floor is completed on the south-side of the building, and all the tanks have been erected and are now being lined internally with protective coatings. The first main condenser is installed, and the second and third are in an advanced stage of erection. These condensers are being supplied by Hick Hargeaves & Co. Ltd.

Good progress is reported on the erection of the first set of feed-heating plant and extraction pumps. The hydrogen water/water coolers on the north side of the first turbo-generator blocks have now been assembled in position, and the copperwork between the first two blocks erected as far as possible. The 42-in. inlet and outlet valves in the circulating-water system on the north side of the basement have been fitted, and the pipework to serve Nos. 1 and 2 turbo-generator sets is nearly finished. The racks over the c.w. culverts are ready for receiving the cables, having been extended under the operating floor of the turbine house. Under the control room, the Mulsifyre-system diesel pumps are installed, together with the refrigerating plant, ductwork, and fans for the central control-room air-conditioning system. The first of three 1,000-kW emergency diesel generators is to be erected in the basement of the turbine house. These sets will be used to supply the essential power station auxiliaries in the event of a failure of the incoming supply to the station.

The h.p. and l.p. steam-receivers have been placed in position and fitted with their valves; in addition, the pipe supports for the steam and feed ranges have been grouted in under the operating floor, and more than half of the pipework for the first part of the contract has already been erected, the remainder being available on site. Near the centre of the south annexe, both dump condensers with their desuperheaters will be located, and much of the supporting steelwork is finished. The lift communicating between all floors of the building is ready for testing. The floors of the switch and battery rooms on the north side of the turbine hall have been completed, and most of the switchgear for the first half of the contract is already in the building.

Ancillary buildings

The workshop to the east of the turbine house is nearly complete so far as cladding is concerned, and the crane is already installed. A "clean conditions" workshop has been constructed inside this building which is being used for the final cleaning of the steam-raising units. The uranium and graphite store is very nearly complete. The charge-machine maintenance building, to the south of reactor "B," is linked to both reactor structures by means of rail tracks. These serve to bring the charge

machines, which are at ground level, into the building for servicing. This building is practically finished, an interesting feature being the inclusion of a "clean-conditions" tower, a necessary adjunct when carrying out maintenance on the interior of the charge machine. A 45-ton crane is installed in the tower for lifting the top off the machine, together with a 25-ton crane in the main hall area. The walls of this building have been constructed from specially-fabricated concrete slabs erected inside the main framework in order to present a completely smooth surface for ease of decontamination if necessary. The building will also be equipped with a "rehearsal" shaft and a complete set of control equipment. The concreting of this shaft is complete, but the installation of the control equipment will be delayed until nearer the time that the first reactor is made critical. Between the reactors, in the space used initially for prefabricating concrete floor sections, the cartridge cooling pond had been re-excavated. It will, perhaps, be recalled that the blasting for the pond was carried out at an early stage, to avoid later disturbances to the reactors, the broken rock being left for subsequent removal. Most of the concrete lining has been poured, and additionally, the conveyor tunnels to the block-houses are virtually finished. The cartridge cooling pond is about 186 ft. long by 53 ft. wide by 18 ft. deep, the capacity being such that the complete fuel charge of one reactor can be dumped into it in the case of emergency. The pond is divided into three sections—two small and one large. Under normal conditions, the two smaller sections will store the discharged cartridges, from the two reactors. In the event of an emergency discharge, the larger pond section will be brought into use. Excavation work is proceeding on the foundations of the active-solid-waste building. About half of the associated tunnelling is finished, and steady progress is reported on the blinding and asphalting. The active-waste disposal plant, on the south side of the two reactors, comprises the treatment house, delay tanks, and cartridge pond sludge tanks. The delay-tank walls and protective brickwork, and the associated pumphouse are well on the way to completion. The walls and asphalt tanking of the sludge tanks have been finished and the brickwork for them is at an advanced stage. Other buildings in varying stages of erection are the decontamination building, the laundry, and feed treatment and filtration buildings. The sewage treatment plant and the pumphouse dealing with the normal foul sewage and storm water from the station are already in operation. Main drainage and water services are also practically finished.

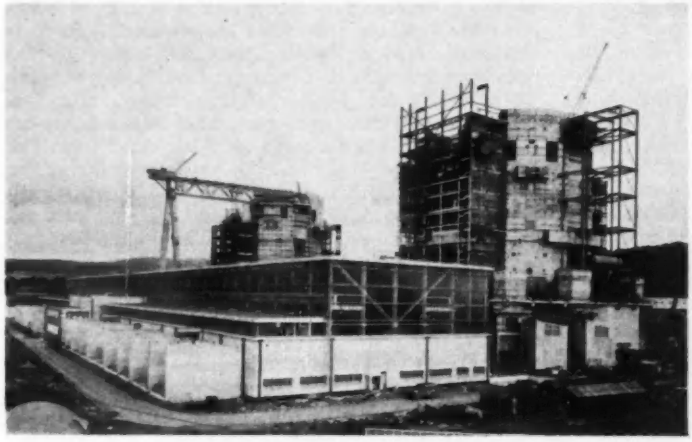


Fig. 7. The two reactors and the exterior of the turbine house viewed from the north.

British Standard for Miniature Smoke Chart (B.S. 2742M)

When the British Standard Ringelmann chart is used to assess smoke density, it needs to be located at a distance from the observer, and in a particular position in relation to the smoke discharge being examined. Such a limitation makes its use inconvenient in certain circumstances and attempts have been made to devise other means of comparison which are not so restricted. B.S. 2742M—a miniature smoke chart—has been developed for just this purpose. The grey shades painted on the chart have been found to give results in good agreement with those obtained by the Ringelmann chart. The miniature smoke chart is not, at this stage, offered as a complete substitute, but it is hoped that experience with it will confirm the preliminary findings and enable it to achieve equal status with the Ringelmann chart proper. An amendment (PD 3901) to B.S. 2742M "Notes on the use of the Ringelmann Chart" has been issued to explain the method of use, and a summary of it is printed on the envelope containing the miniature smoke chart. Copies of this standard may be obtained from the British Standards Institution, Sales Branch, 2, Park Street, London, W.1, price 3s. single copies; 12 for 24s., and 144 for £10 0s. 0d. (Postage will be charged extra to non-subscribers.)

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The South of Scotland Electricity Board have awarded to **Associated Electrical Industries Limited** the contract for the supply and erection of crossing towers, anchor towers and conductors for the crossing of the river Clyde by the 275-kV supergrid near Erskine Ferry, near Glasgow. The crossing towers, of Blaw Knox design, will be 371-ft. high with a 60-ft. square base. They are designed to carry twin 0.4 sq. in. steel-cored aluminium conductors, and will allow a specified clearance of 240-ft. to high-water mark of the Clyde. Distance between anchor towers is 0.65 miles in a direct line. A.E.I. Construction (Cables & Lines) Division will carry out the work, which is scheduled for completion in December, 1961.

Opportunities for careers in the instrument industry are outlined in a brochure issued by **Negretti & Zambra Limited.** Details are given of the entry qualifications of the three classes of apprentice—craft, engineering and student—the type of training provided and the subsequent careers open to the candidates. Copies of the booklet can be obtained from the company at 122, Regent Street, London, W.1.

* * *

A recent publication produced by **Henry Wiggin & Co. Ltd.** and entitled "Some Applications of Nimocast Heat Resisting Alloys," explains briefly the composition and available types of casting in the Nimocast Series of nickel-chromium alloys. Many of the applications, which are illustrated, are components of British gas-turbine engines, such as turbine-stator blades, rotor blades, discs and rings. The publication, which gives an indication of the range of forms which can be cast in the Nimocast Series of alloys, is obtainable free on request from Publicity Department, Henry Wiggin & Co. Ltd., Thames House, Millbank.

N.I.F.E.S.—Sixth Annual Progress Survey

IN his annual statement, Sir Leslie Hollinghurst, G.B.E., K.C.B., D.F.C., chairman of the National Industrial Fuel Efficiency Service, expressed his belief that the period covered by the sixth annual survey (April 1st, 1959, to March 31st, 1960) marked the beginning of a new stage in the development of the service. Sir Leslie's statement was presented on the occasion of the sixth annual progress survey presented in London on October 6th, 1960, and mentioned that when the organisation commenced operations in May, 1954, they had a guarantee of financial support for a period of five years. The five years came to an end in March, 1959, thus the period under review marks the first year of the second period of five years during which the fuel industries have agreed to sponsor N.I.F.E.S.

Reflecting on the first five years, the statement recalls that in 1954 the country was still suffering from a serious shortage of fuel. By 1959, however, this shortage had been overcome, and ample supplies of fuel had become available for almost every purpose. In view of these changed circumstances there is now a need to examine the policy of N.I.F.E.S. and to restate its purposes, as the balance between the advantages to the nation, and the benefit to industry have been shifted, and fuel efficiency has proved far more attractive financially than was expected. The advantages that industry secures from the services are now well established, and it is the Board's belief that N.I.F.E.S. clients will agree that this branch of the work should be self-supporting. It therefore proposes that by increasing some of the fees from January 1st, 1961, the trend towards recovering the full costs will be accelerated.

The past year has been a difficult but successful one, nearly 1,000 clients were contacted for the first time, and the total number of visits made was 12,879—which was higher than in the previous year, whilst the earnings of £182,391 represent an increase of nearly 10 per cent. over those in the previous year. Business booked during the year was for the first time in excess of £200,000, as compared with £172,187 last year—an increase of 18 per cent. The board, therefore, feels justified in expressing great confidence in the future of the service.

Development of the service

The problems in which N.I.F.E.S. has been asked to advise in all branches of the service has lately become more intricate, resulting in the increased duration of contracts. In order to convince industrialists that it was possible to effect savings and economies at their plants it was originally essential to carry out a heat and power survey—one of N.I.F.E.S. paid services which determines by accurate measurement, the heat-losses occurring, and fuel savings which can be made. However, as confidence in N.I.F.E.S. engineers has increased, industrialists have become more ready to accept their judgment of the situation without resorting to the heat and power survey. This situation has come about now that N.I.F.E.S. engineers can back their advice with a record showing average savings of 15 per cent. on over 2,400 boiler plant investigations.

In by-passing the heat and power survey, the cost to the client is, of course, considerably reduced. However experienced the engineer, there is a limit to the progress that can be made by visual observation. The need for access to exact information is appreciated and several thousand measuring instruments, which represent an investment at a cost of £165,000, have been provided. Each of the nine areas, therefore, has some £20,000 worth of instruments available. In order to maintain the standard of accuracy of these instruments, care, maintenance and frequent calibration are essential. To meet this need, each of the area offices is equipped with maintenance and repair facilities, and after use, each instrument is carefully checked for accuracy, before it is issued again. Additionally, a central repair depot has been established in Leeds to carry out major repairs or calibrations. In order that the use and siting of the most suitable instruments can be obtained, an instrument manual covering these problems has been published and issued to each engineer on the staff during the year.

As mentioned earlier, N.I.F.E.S. engineers now have the backing of tests carried out on a considerable number of boiler plants. The total number is 2,406, of which 2,046 are coal-fired, and 360 oil-fired. The boilers are classified under four main headings:—vertical, Lancashire, economic and water tube types. In previous progress surveys, investigations into the improvements of the combustion of boiler fuels have been reviewed. These investigations continue successfully, and the number carried out during the past year exceeds the previous yearly average.

Engineering and metals

Heat-treatment furnaces which are often found in the engineering industry have been frequently examined over the year, and fuel consumption has been found to vary considerably with the purpose for which the furnace is used. A successful example of a furnace for annealing non-ferrous metals which has been improved by N.I.F.E.S. engineers is a recuperative oven, gas-fired and operating under natural-draught conditions. It is in constant use six days a week for annealing coiled and strip sheet brass at temperatures from 650 to 700 deg. C. By carrying out various improvements, the gas consumption per ton of metal heated was reduced by 23 per cent., and a reduction was effected in the time required to heat a batch of metal from 180 to 155 min. The output was thus increased by 16 per cent., and an improvement in quality was achieved. To illustrate the comprehensive nature of the service which N.I.F.E.S. provides, the work carried out for Joseph Lucas Limited is quoted. Surveys have been carried out on three high-pressure hot-water boiler plants, high-pressure hot-water process equipment for plating, degreasing, washing, etc., gas and oil-fired furnace plants for aluminium, zinc and lead-melting and casting foundries and bulk melting of aluminium, lead and reclaimed scrap, and, finally, gas-fired heat-treatment furnaces and enamelling, bonderising, drying, blacking, impregnating and other large dipping and drying ovens. A significant saving

has been achieved in that the cost of fuel for the high-pressure hot-water boilers has been reduced by £10,000 per annum and by investigating operating techniques, efficiencies as high as 84 per cent. have been achieved for the specialised oil-burning equipment which Lucas themselves have developed. Improvements of a similar nature in the other plant mentioned have caused Lucas's to ask N.I.F.E.S. engineers to advise them on operational aspects of new projects. N.I.F.E.S. engineers, says the survey, have acquired such a wealth of operating experience in the course of their very varied investigations, that they can provide second opinions of value even to the largest organisations who desire to effect an improvement in the efficiency of their plant.

A NEW DOUBLE-DRUM CONVEYOR DRIVE

Though a single driving-drum is often suitable for driving a belt conveyor, in many cases the larger wrap obtained from two driving-drums is an advantage, especially for long conveyors, or where, for any reason, high power has to be transmitted to the belt. Both kinds of drive are made by Mavor & Coulson Limited, Bridgeton, Glasgow, who have recently extended their range of double-drum drives by producing a smaller size—the No. 2T, of 40 to 70-h.p., for belt widths from 24 to 42-in.; the path of the belt round the two driving-drums providing a wrap of 480°. The cheeks are strongly-ribbed castings, joined by heavy cross-stays in order to form a rigid structure preserving the alignment of the moving parts. This structure needs no baseplate or foundations, but can stand directly on any floor or made-up ground, requiring only that the floor can support a bearing load of 1-ton/sq. ft. (15½ lb./sq. in.). As mentioned above, the range covered is 40 to 70 h.p., the lowest belt speed at which the driving gear can accept any of these full powers being shown by the graph in Fig. 2. Motors can be either flange or foot mounted, and a fluid-coupling can be included if this should be desired. Standard equipment includes a brake for bringing the conveyor to rest when the motor is switched off, so that it does not continue to run for any appreciable time, and for holding a loaded belt on a gradient. The brake is released by a thrustor, and it is put on by a weight located above the thrustor.

The first speed reduction is by double helical gearing, and the second by straight-cut gearing with a large spur wheel on the shaft of each of the two driving-drums. The teeth of the gears are made to a high degree of accuracy and run with the minimum of noise in oil. Seals are provided to protect the bearings. The diameter of the driving drums is 25-in., each drum being made of an accurately-turned shell spigoted to cross-shaped plates which are welded to the shaft.

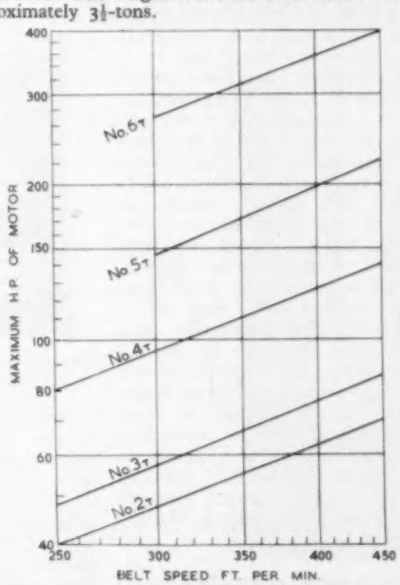

Fig. 2 (above). Graph showing the greatest power of motor that can be taken by Mavor & Coulson double-drum drives, depending on the speed of the belt.

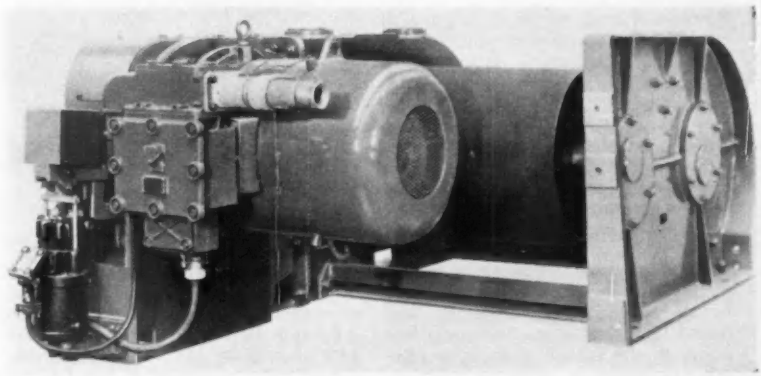

Fig. 1 (left). General view of Mavor & Coulson No. 2T drive, with brake guards removed.

When installed in certain locations, access can only be had conveniently to one side of the drive, and a feature of the 2T is that it can always be placed so that the brake and all the gearing and gearcases are on the accessible side, for when necessary the drive can be changed from one hand to the other. The bearings of the driving drums are carried in eccentric housings, and to change the hand, the housings are reversed, raising one drum and lowering the other. The width of the drive is small, for on the gearcase side the greatest width is 1 ft. 10 in. beyond the belt, and on the other side as little as 11¾ in. These dimensions include a brake; but if a fluid-coupling is also included, the motor projects about 2-in. beyond the 11¾-in. dimension for a 42-in. belt, or correspondingly more for a narrower belt. The weight of the drive as illustrated in Fig. 1 is approximately 3½-tons.

Lancashire Dynamo Electronic Products Limited, Rugeley, Staffs., announce that they are making immediate price reductions to their range of comprehensive resistance welding controls (Series CRW.1). The reductions, which average 10 per cent. on previous list prices, have been made possible by rapidly increasing production and improved methods of manufacture of this versatile equipment. The Series CRW.1 provides a range of 42 different types of equipment in a common basic cubicle assembly including installations for synchronous spot seam, pulsation (or "Woodpecker") welding.

RECENT Equipment AND Accessories

High precision Versa-Tran temperature control

A new fully-transistorised printed circuit amplifier-relay for use as a stable, sensitive, temperature-controller, has recently been introduced by Honeywell Controls Limited. With the appropriate thermistor temperature sensor, the "R7079/7081 Versa-Tran" can be used for control in the range of − 60 deg. F. to + 500 deg. F. with a differential of 1.5 deg. F. or 0.3 deg. F. depending on the model. Control is very stable, and errors due to ambient temperature conditions are easily compensated for by means of a calibration dial. Wiring between sensing-element and relay need not be shielded; the bridge presents no capacity balance problems; ordinary 18 s.w.g. two-conductor insulated cable will suffice. The control, which incorporates the load-relay, can, it is claimed, be used up to 300 ft. from the thermistor, and operates from the 240 V 50 c/s supply. Versa-Tran controllers are available for surface mounting, flush-mounting, or mounting in most electrical enclosures. For full details, specification S1010-6 is available on request from Honeywell Controls Ltd. (*Honeywell Controls Limited, Ruislip Road East, Greenford, Middlesex.*)

Arca three-term controller

The Arca pneumatic controller has been designed as a receiver controller for use with pneumatic transmitters having an output pressure range of 3-15 lb./sq. in. It is of the non-indicating type, with desired value scale calibrated in the appropriate units. The controller is available with proportional, proportional integral, or proportional integral and derivative adjustments. If required, pneumatic adjustment of the desired value can be provided. A force balance system is employed for the control mechanism ensuring reliability and freedom from maintenance problems. To facilitate servicing, unit construction is used, the controller being built from three sub-assemblies. The controller sub-assemblies are as follows:—(a) Control mechanism assembly; (b) Gauge-mounting plate, incorporating proportional, integral and derivative restrictors; (c) Base-plate with air-connectors, air-switch. The control mechanism assembly comprises the impulse, proportional and integral bellows, which are arranged to exert forces on a "T" lever, or flapper, controlling the air-flow through the air nozzle. A dual nozzle system is used, so that reversal of controller action is achieved simply by making the desired selection on the air switch. Selection of normal or reverse action on the air switch

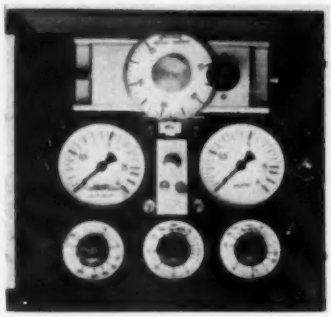

Fig. 1. Arca three-term pneumatic controller. (British Arca Regulators Limited.)

necessitates a simple re-adjustment of the desired value dial. Pressure gauges on either side of the throttle unit are provided for the indication of the input and output air pressure, while a replaceable cartridge filter protects the air circuit from the ingress of foreign matter. The instrument is enclosed in a steel dust-proof case, which is fitted with a hinged front and is suitable for wall or panel mounting. (*British Arca Regulators Limited, Sisson Road, Gloucester.*)

Smoke density monitors

Radiovisor Parent Limited have developed two standard smoke density indicating and alarm equipments—units RV.2 and SA.56, to conform, respectively, to B.S.S. No. 2811 and B.S.S. No. 2740. These units, immediately after development, were tested by an independent laboratory, and found to meet the requirements laid down in the British Standards. Recent negotiations with the British Standards Institution have resulted in official recognition of the quality of manufacture of these Radiovisor units, and the test procedure used to ensure consistency of product. Licence numbers 3274 and 3275 have been allocated by the British Standards Institution authorising endorsement of the Smoke Density Indicator type RV.2 and Smoke Alarm type SA.56 equipments with the "Kite Mark." (*Radiovisor Parent Limited, Stanhope Works, High Path, Merton, London, S.W.19.*)

New version of semi-automatic welding process

Rockweld Limited have recently introduced what is known as the "Comet Series II" process for semi-automatic welding. This new version embodies several improvements. The CO_2-cylinder is now mounted on the trolley which transports the equipment (Fig. 2). The modified wire-drum incorporates a tension device, which, with an improved feed-box, enables one coil to be fed in after another, thereby eliminating wastage of 15 ft. of welding wire. The process will now permit two alternative sizes of wire spool—one of 12 in. and the other of 16 in. nominal bore. The original equipment was intended for use with the Rockweld Autopak welding transformer. In this new version, the design enables it to be

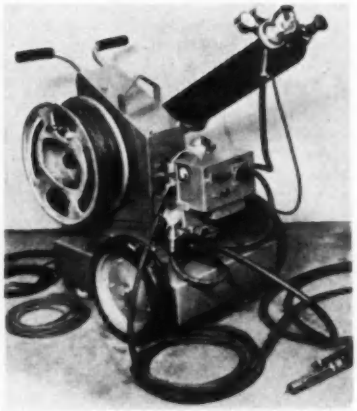

Fig. 2. Semi-automatic welding process equipment. (Rockweld Limited.)

supplied by any welding power source of sufficient capacity, either a.c. or d.c., and the head has been modified and control of arc volts simplified. The Comet process is believed to be the most economical and practical method of semi-automatic welding on all applications for plate thicknesses of $\frac{1}{4}$ in. and above, and to be the only CO_2 semi-automatic process in this country capable of providing perfect welds, completely free from porosity, on rusty, or even scaled, steel plate. (*Rockweld Limited, Commerce Way, Croydon, Surrey.*)

"Conflo" steam trap

The "Conflo" steam-trap, Series 2 (Fig. 3), was introduced by Royles Ltd. several years ago in the ½ in. and 1 in. sizes only, and having proved most satisfactory, the 1½ in. and 2 in. sizes have now been added to complete the range. Designed to give a continuous flow of condensate, the trap is equipped with a thermostatic release-valve, the rate of discharge, being within the limits of the capacity of the trap and is adjusted to the speed at which the condensate is flowing. The body is made from high quality cast-iron, and has clearly marked inlet and outlet connections, whilst the cover, also of cast-iron, carries the valve and float assembly, with a cored passage leading to the outlet connection on the body. The discharge is formed from stainless-steel pressings with a renewable stainless-steel valve and seat, designed to give a high multiplying ratio to the stainless-steel ball-float which is attached to the moving part of the valve-housing. An important design feature is the provision of a thermostatic air release-valve, the operation of which is controlled by a scientifically balanced bi-metallic strip. This ensures the free venting of air on starting up, and the prevention of failure by air-locks during working periods. The whole of the mechanism which is attached to the cover, may be withdrawn for inspection without removing the body of the trap from the piping. The "Conflo" Series 2 Steam Trap can be equipped with valves to cover the following pressure ranges:—l.p.—up to 25 lb./sq. in., m.p.—25 to 100 lb./sq. in., and h.p.—100 to 200 lb./sq. in. All traps are tested hydraulically to 400 lb./sq. in. and under steam for the range of valve fitted. (*Royles Limited, Irlam, Manchester.*)

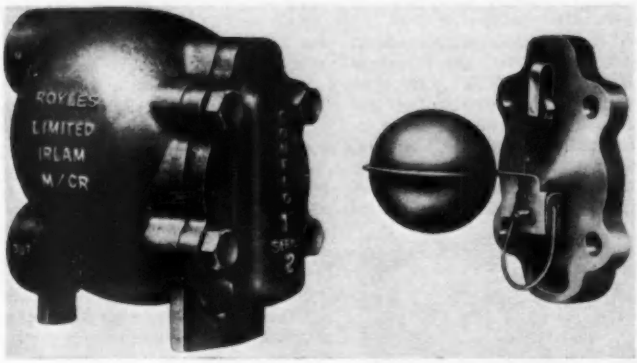

Fig. 3 (left). The "Conflo" Series 2 steam trap. (Royles Limited.)

Metalife Duplex metal coating

Metalife Liquid Metals Limited, have recently introduced a new product for the long term rust-proofing of iron and steel. This new coating, it is claimed, makes such protection far more economical than did its predecessor by virtue of improved design technique. The new product is Metalife Duplex metal coating, and is a two-pack Metalife system consisting of a base and a solidifier which, when combined, give a metal coating having a resistance to corrosion, abrasion, solvents and chemicals. It is claimed to withstand temperatures from 65 deg. F. to 400 deg. F. dry heat and is non-toxic. Metalife Duplex also gives in one brushed application a double thickness coating, which means that where normally four protective coats would be required, only two coats of Metalife Duplex will now be needed. This reduces the application time, by half, a significant factor for contractors or where plant in operation is involved. The coating is also quick-drying—it can be overcoated in six hours. A double-thickness coating should mean half the coverage per cwt. of Metalife used, but Metalife Duplex gives 10 per cent. more than half—an actual coverage of 1,400 sq. ft./cwt. Two brushed coats of Metalife Duplex deposit 2.1 oz. of anodic metals per sq. ft., equivalent to good quality galvanizing. An additional advantage of Metalife Duplex is that it can be applied to damp surfaces—an important consideration for open air site work, and the manufacturers claim that due to its structure it does not sag, drip or run when being applied, and is, therefore, economical to use. Protective coatings with a high metal content are often subject to settlement, which can affect the method of application. This problem is claimed to have been completely solved with Metalife Duplex, as settlement is negligible. This new product, developed by the Metalife Group Laboratories, has been thoroughly tested under severe laboratory and site conditions. (*Metalife Liquid Metals Ltd., Harrogate, Yorks.*)

New lightweight X-ray unit

A new portable X-ray unit of 150-kV capacity and a weight of 51½ lb., has recently been introduced by Pantak Limited. The new unit shown in Fig. 4, and known as the "Baltospot G150," is available in two models, the type "D" head having a 60° field whilst the type P has a 360° field. In both units the beam-angle is 35° and the head is offset. The focal-spot size of the tungsten target is 1.5 mm. × 1.5 mm.

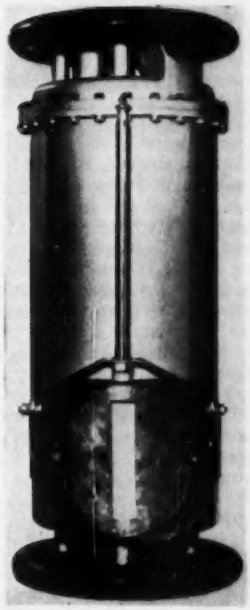

Fig. 4 (right). New lightweight X-ray unit. (Pantak Limited.)

in the E150D, whilst that for the G150P is 0.8 mm. × 2.1 mm. A particular feature of the offset-head is its use, especially in the panoramic version, in the examination of closed vessels of small diameter, the examination of a 3 ft. dia. tubular vessel with a welded-dished end being well within the capacity of the unit. Sulphur hexafluoride is used for both insulation and cooling of the X-ray tube, forced-circulation cooling of the anode being effected by means of an internal blower. The tankhead is of drawn aluminium with bolted dished ends and amongst the numerous protection devices fitted are shock-absorbent mountings for the tube in the tankhead and further shock-absorbent mountings for the tankhead in the cradle. A thermo-switch is fitted to guard against excessive temperature rises. The length of the tankhead is 1 ft. 9 in. and the dia. is 8¾ in., the weight being 46 lb. The weight complete with end rings is 51½ lb. and the weight of the protective cradle is 6½ lb. The control unit operates from a 220 V

50/60 cycle a.c. supply, using 6 amp. and accommodates mains fluctuations of 10 per cent. either way. Stepless-type kilo-voltage and tube-current controls are incorporated, giving continuously variable control. Experimental exposure charts for 16 in. and 28 in. focus/object distances are supplied in the lid. The dimensions of the control case are 1 ft. × 9¾ in. × 6½ in., the weight being 27 lb. (*Pantak Limited, Vale Road, Windsor, Berks.*)

New temperature indicator-controller

A new electronic temperature indicator-controller (Fig. 5) is now available in the Fielden "Bikini" range of instruments for temperature measurement. Like the "Bikini" indicator it is housed in a 6 in. dia. panel-mounting case and has a 13 in. scale calibrated in deg. C. or deg. F. (in any of 73 standard ranges for temperatures between − 200 deg. C. and + 850 deg. C. (− 330 deg. to 1,550 deg. F.). The control point is set by a pointer operated from the knob in the centre of the dial, whilst the indicating pointer is motor-driven from a servo-system. The instrument is completely transistorised for reliability, and no maintenance is said to be required. It can be operated from 12 volts d.c. or the usual mains supply. The flush-mounting meter-type case takes up a minimum of panel space and combines modern appearance with ease

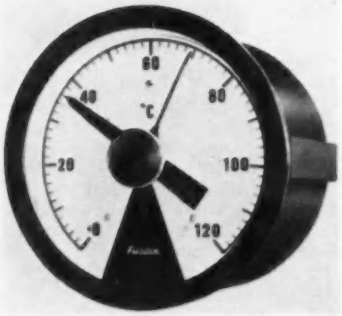

Fig. 5. New temperature indicator/controller. (Fielden Electronics Limited.)

of installation. The platinum resistance-measuring bulb used with the indicator-controller is housed in a robust stainless-steel sheath of ¼ in. dia., and can be located at any distance up to 300 ft. away from the instrument. The control-relay, which has contacts rated at 10 amp. to provide both changeover and "normally open" switching, can be located up to 300 ft. or more away from the instrument if required. All interconnections are made with simple electric cabling having no effect on the performance or calibration of the indicator-controller which, being electronic, provides an instantaneous response between measuring point and instrument, and instrument and control-relay. The makers claim a calibration accuracy of ± 5 per cent. of the scale and a repeatability of 0.25 deg. C. on most ranges. Large-scale production has already commenced and many of the 73 ranges are now available. (*Fielden Electronics Limited, Wythenshawe, Manchester.*)

Double-volute pumps

Under the terms of an agreement recently drawn up with the Bingham Pump Company, U.S.A., pumps to the American company's design are to be manufactured and marketed by David Brown Industries Limited. The pumps concerned are of the double-volute, horizontal, single-stage centrifugal type (Fig. 6), and

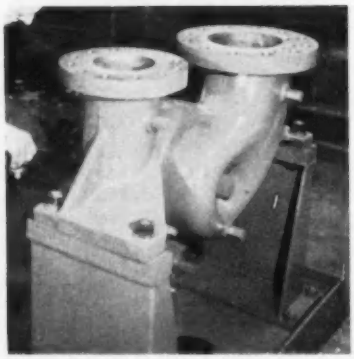

Fig. 6. Double-volute horizontal single-stage centrifugal pump. (David Brown Industries Limited.)

these are claimed to overcome the inherent defect, unbalanced hydraulic-pressure in the pump case—of pumps of single-volute construction. It is claimed that with the development of the double-volute construction which will be embodied in all David Brown-Bingham pumps, hydraulic radial-balance has been established, eliminating deflection of the rotating element throughout the entire operating range. This is achieved by making the double-volute pump case in the form of two exactly similar volutes, each spanning half of the impeller circumference. At any two points on opposite sides of the impeller, the shape and area of the adjacent casing and the velocity of flow therein are respectively equal. By virtue of this design, hydraulic pressure, acting radially against the impeller at any point, is balanced by an exactly equal pressure acting against the opposite side of the impeller—regardless of head capacity, or speed at which the pump is operating. Tests carried out on every pump before despatch are designed to show (a) the performance curve and (b) suppression data. In order to obtain a performance curve, the output of the pump in gal./min. is measured for various suction and discharge-pressures. From this data, curves for dynamic-head, brake horse-power and efficiency are plotted against pump-output in gal./min. A suppression test determines the nett positive suction head at which a pump will operate for a given output. The design of the David Brown-Bingham pump is claimed to be such that the rotating elements can be replaced on site without disturbing the main pipe connections to the pump. This means that users can carry spares and do not need to hold stand-by units. (*David Brown Industries Limited, Foundries Division, Penistone, South Yorkshire.*)

New nozzle extractor tool for oil burners

Shandon Scientific Co. Ltd., Combustion Instruments & Accessories Division, have introduced a new tool for the use of the heating engineer and oil-burner manufacturer. It is known as the "Ideal" nozzle extractor. The manufacturers claim that this tool (Fig. 7) enables oil-burner nozzles to be removed or replaced in 40 sec.—without moving the burner assembly, and without any danger of damaging the electrodes. The tool

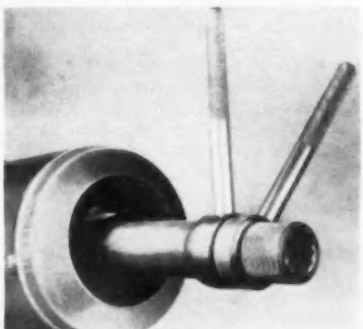

Fig. 7. Nozzle extractor tool for oil burners. (Shandon Scientific Co. Ltd.)

is inserted through the fire-door, and fits all normal types and makes of nozzles. The "Ideal" nozzle extractor comprises three socket-wrenches in one compact tool. An inner-socket, which fits the nozzle-tip, revolves inside an outer tubular-socket, which in turn engages the adaptor. Both inner and outer-sockets are fitted with a 4-in. knurled handle attached at right-angles. After positioning the tool on the nozzle and adaptor, the knurled handles are

brought together (a one-hand operation) loosening the nozzle. Spinning the handle of the inner-socket completes disengagement of the nozzle, which remains in the tool while it is removed from the burner, the nozzle being replaced by reversing this procedure. The reverse end of the tool carries a third socket designed to hold the nozzle-tip firmly while it is dismantled for cleaning. The "Ideal" nozzle extractor is included in the new Fyrite "Plus Two" service kit, also marketed by Shandon Scientific Co. Ltd. (*Shandon Scientific Co. Ltd.*, 6, *Cromwell Place, London, S.W.*7.)

Hagan ring balance meters

Hagan Controls Limited, the company recently formed between the Plessey Group of Companies and Hagan Chemicals and Controls Inc., U.S.A., announce that the full range of Hagan ring balance meters is now available in this country. In these meters the differential-pressure produced at the measuring point in the flow-main is brought to the toroidal-ring of the meter by means of flexible S-tubes. A feature of these tubes is that their configuration and metal-to-metal fittings provide safe and completely flexible connectors which preserve the meter's inherent high-sensitivity throughout the range. High sensitivity at low flow rates is made possible by what is said to be a unique range-calibration system. This system also allows the meter to be easily calibrated under operating static-pressures (with accurately made check-weights), without disconnecting any pipework. Ring assemblies on the meters are interchangeable to provide full-scale ranges of from 0.5 in. w.g. to 560 in. w.g. and for static-pressures of from 5 lb./sq. in. g. Facilities exist for range adjustment of any one ring over a 3 : 1 differential range and the meters can be fitted with either pneumatic or electric transmission as required. Other interesting features which can be embodied include:—pressure and temperature-compensating devices; up to two flow-measuring elements and four recording pens can be incorporated in one meter; the integrator is easily checked and readings can be taken without opening the meter case; no mechanism is in contact with the fluid under measurement, calibration is independent of the nett density and quantity of the sealing-liquid. The basic function of a meter of this type is the measurement of fluid flows. However, over the past few years, many other applications have been developed. The basic construction lends itself to many standard modifications, and, with accessory linkages, the meters can be used for such operations as computing, ratio-control, or as transducers with data-logging systems. A dual-ring meter, for example, with both rings housed in the same case, may be used to record and integrate two different flows, control their ratio, or calculate their sum or difference. (*Hagan Controls Limited*, 14, *Grosvenor Place, London, S.W.*1.)

Dynoscreen continuous screen-type centrifuge

The recently-introduced Dynoscreen continuous screen-type centrifuge is a compact unit of established design for the separation of solids from magmas and slurries. The machine has many applications in the food, chemical and mining industries, where its design meets modern screening requirements effectively and economically. The Dynoscreen

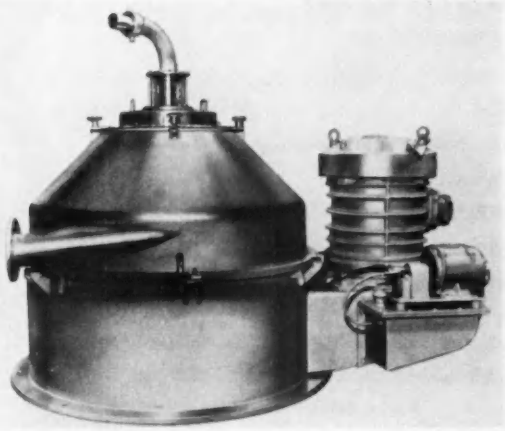

Fig. 8. 'Dynoscreen' continuous screen-type centrifuge. (International Combustion Products Limited.)

(Fig. 8) can function either as a centrifuge or centrifugal-screen, handling a wide variety of materials. Fibrous and granular-solids as well as powdery materials possessing free-draining characteristics are easily separated, and it is not essential for the specific gravity of the solids to be greater than that of the liquor in which they are suspended. When used to separate crystals from magma, the Dynoscreen will deliver a product of uniform dryness into a dryer at a continuous rate. Another application is the removal of the liquor occluded by plastics during polymerisation. The Dynoscreen is claimed to have the capacity and operating efficiency to satisfy the demands of many different industries: low power requirements, simplicity of operation, ease of installation and maintenance are other important advantages. (*International Combustion Products Limited, Nineteen Woburn Place, London, W.C.*1.)

High-speed X-ray development

An industrial X-ray picture can, it is claimed, now be developed in 15 sec. with equipment now commercially available in Britain for the first time. The process—known as "xeroradiography"—harnesses the speed and low cost of xerography (dry, electrical photography) to X-ray work. No darkroom or wet chemicals are used and, in many cases, xeroradiography clearly reveals the faults which are difficult to detect by conventional X-ray methods. It has a wide range of applications including the inspection of light-alloy castings, hidden structures, assemblies, potted circuits and welds. A unique feature of xeroradiography is that the image contrast is, under normal conditions, shown to be accentuated at sharp boundaries and for small details such as cracks, pinholes, etc. The overall contrast is, however, low and a large thickness-range can be accommodated in one exposure. This feature can lead to considerable economy in the number of radiographs necessary for a given examination. Another attractive feature is that any number of photographic prints, of any convenient size, can be produced containing all the details of the original image. The equipment is manufactured by Rank-XeroX Limited, and marketed by Watson & Sons (Electro-Medical) Ltd. The sensitive element detecting the X-ray image is a thin layer of photo-conducting selenium on a metal backing-plate. This plate is sensitised by giving the selenium-surface a uniform electrical charge. On exposure to X-rays, the selenium conducts charge to the backing-plate by an amount depending on the X-ray intensity and hence an electrical image is produced on the selenium-surface. This image is made visible by blowing charged-powder against the selenium; it is then viewed by side lighting in a viewer which screens off ambient light. A built-in 35 mm. camera is used to make a permanent record of the image. After viewing, the powder is removed by a revolving-brush and the plate can be used again. The plate has a sensitive area of

For the
prevention of corrosion in
condensate systems

HAGAFILM*

In space heaters, process heaters, evaporators and condensate lines Hagafilm forms a non-wettable film that protects vital surfaces from corrosion and improves heat transfer. Hagafilm has for long been used in America with striking results.
Now in the United Kingdom it is showing the same efficiency, and reducing maintenance and replacement costs considerably.
Albright & Wilson advice and technical service on the use of Hagafilm in the solving of water treatment problems is freely available.

* *Registered Trade Marks of Albright & Wilson (Mfg) Ltd.*

Look to **ALBRIGHT & WILSON** chemicals for

For controlling corrosion
and preventing hard water scale formation
in water heating and cooling systems

CALGON*

For small installations—MICROMET *

Threshold treatment with Albright & Wilson's Calgon (glassy sodium metaphosphate) has been firmly established as a reliable method of controlling corrosion and preventing hard water scale. Threshold Treatment is applied by adding a few parts per million of Calgon to the water used in heat exchangers, condensers and cooling systems.

For preventing scale deposits in high and low pressure boilers

PHOSPHATE CONDITIONING

Phosphate conditioning of boiler water is well established as the most satisfactory method of preventing scale deposits in all types of boilers. Scale cannot form when a reserve of phosphate is present in boiler water. Phosphate conditioning is indispensable at high pressures, and leads to such improvements at low pressures that it is generally preferred to other treatments.

Ask your supplier
of boiler conditioning chemicals
how little you would have to pay
to be sure your boiler
is scale free all the time

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Water Treatment Department
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TELEPHONE: KENSINGTON 3422

TBW 323

the answers to water treatment problems

13 in. × 8½ in. and its average life is about 1,000 exposures. The process is completely dry and no chemicals or darkroom is required; development takes 10-15 sec., after which time the image is ready to be viewed. The cost of making X-ray pictures by "xeroradiography" is considerably less than that of normal radiography. The resolution of the plates compares favourably with medium-speed non-screen industrial X-ray film and requires about the same exposure. Conventional X-ray apparatus is used. [*Watson & Sons (Electro-Medical) Ltd., Industrial Division, East Lane, North Wembley.*]

Electrically-operated 2-in. "Univac" pump

An electrically-operated 2-in. "Univac" self-priming centrifugal-pump is now being produced by Henry Sykes Limited, having a capacity of 6,500 gal./hr., when operating on a suction lift of 10 ft. and a nominal head. At nominal lift, and a total head of 20 ft., the output is 8,000 gal./hr. The pump will pass solids of up to 1 in. dia., and will pump slurries of up to 60 per cent. solids content. On a 10 ft. suction, the pump will prime in 12 sec., whilst on a 28 ft. suction, the priming time is 65 sec. The operating principle of the "Univac" pump consists of the maintenance of a partial vacuum in two chambers which are above the centre-line of the pump and which precede it in the suction line. These chambers are interconnected and the partial-vacuum is maintained in them by a small rotary vacuum-pump. The function of the first of these tanks is to gather any air which may pass up the suction line and to maintain a reservoir of water, the duty of the second tank being to prevent water reaching the vacuum-pump. The pump, shown in Fig. 9, and impeller have been designed to handle sludges and pulps containing appreciable solids in addition to duties where only clear water or other liquids are involved. The pump castings are thus of close-grained cast-iron, as are the casing wearing-plates and the impeller. The shaft is of mild-steel with renewable sleeves and is, in effect, the extension of the motor-shaft. The pump is close-coupled to a 3 h.p. English Electric 3-phase, 50 cycle, 400/440 volt motor, although other motors may be fitted as required, where, for example, flame-proof operation is specified or where operation is in the range of 100 to 600 volts. The overall length of the unit is 3 ft. and the width is 1 ft. 6 in. The height is 3 ft., the total weight being 480 lb. net. (*Henry Sykes Limited, Southwark Street, London, S.E.1.*)

Fig. 9 (left). Electrically-operated 2-in. "Univac" pump. (Henry Sykes Limited.)

New torque-controlled impact wrench

A new torque-controlled, reversible, impact wrench, designed for close control of final bolt tightness, has been introduced recently by the Consolidated Pneumatic Tool Co. Ltd. This new wrench operates as a conventional wrench until the pre-set-torque value is reached, when the torque-control device cuts off the air supply to the motor and the wrench ceases to impact. The required loading is obtained by the operation of a torque-adjustment screw located on the handle of the wrench and a lock-out button on either side can be pressed to lock-out the control and allow the wrench to develop its full capacity. The wrench is available in two forms, the "CP.610-RLTP" wrench (Fig. 10) being equipped for spline drive, whilst the "CP.610-RTP" has a 1 in. conventional square drive. Particular features of the spline drive-shanks and sockets are such points as the achievement of maximum safety through positive retention of the socket, since the retainer is integral with the shank and is automatic in operation. A quick-release button in the shank frees the socket for removal. The greater efficiency of the spline connection as compared with square-drive also reduces power losses and enables socket changes to be made with greater speed. This efficiency of power-transfer also results in more even stress-loading of the socket and enables it to be considerably lighter than the equivalent square-drive socket. The weight of each model is 23 lb., the overall length being 16¾ in. The hose size for use with the tool is ½ in., and the inlet pipe thread size is ¼ in. The maximum bolt size, when using the lock-out is 1¼ in., and the minimum torque is 300 ft./lb. the maximum being 600 ft./lb. When bolting resilient materials, the minimum figure can be appreciably lowered and the maximum can be raised when bolting rigid materials. (*Consolidated Pneumatic Tool Co. Ltd., 232, Dawes Road, London, S.W.6.*)

Fig. 10 (right). New torque-controlled impact wrench. (Consolidated Pneumatic Tool Co. Ltd.)

New "Diadem" electrode

A new arc-welding electrode, known as "Opal 3½ Ni," has been developed by Cooper & Turner Limited, for the welding of low carbon 3½ per cent. nickel and similar steels, where good "Charpy Impact" values are required at sub-zero temperatures. This new electrode is designated E616 on the B.S. 1719 coding or E8016-C2 on the AWS-ASTM scale. The basic coating employed is claimed to give a clean weld-metal, free from minute inclusions of slag and gases, in conjunction with easy, fast deposition characteristics in all welding positions. Particular features are the stability of the arc and the ease of slag control which enable d.c. and

a.c. supplies down to 70 volts open circuit to be used. The mechanical properties of the "Opal 3½ Ni" electrode include a "Charpy Impact" value of 15/20 ft./lb. at — 100 deg. C., a yield point of 27/31 tons/sq. in., and an ultimate tensile strength of 34/40 tons/sq. in. The carbon content is 0.5-0.8 per cent., with silicon being 0.25-0.50 per cent. The manganese content lies between 0.4-0.8 per cent. and both sulphur and phosphorus are below 0.03 per cent. each. The nickel content is in the range 3.25-3.75 per cent. The electrode is produced in a range of five sizes from 12 gauge to 4 gauge. The current values range from 90 amps. average and 110 amp. maximum at 12 gauge to 260 amp. average, and 320 maximum at 4 gauge, the deposition time per foot of electrode at maximum current being 51 sec. at 12 gauge and 62 sec. at 4 gauge. The weight of metal deposited per cwt. of electrode rises from 64 lb. at 12 gauge to 78 lb. at 4 gauge, whilst the weight of electrodes required to deposit 100 ft. of fillet weld in the downhand position is 7.5 lb. with a leg length of ¼ in. and 86.5 lb. with a leg length of ½ in. (*Cooper & Turner Limited, Vulcan Road, Sheffield, 9.*)

It is with regret that we record the death on October 16th of **Mr. R. H. Walkerdine,** assistant managing director of our contemporary *The Colliery Guardian.* Mr. Walkerdine, who was 54, entered the mining industry in 1924 as a student at Rufford Colliery, near Mansfield. He attended Nottingham University (1925-1927) where he obtained his B.Sc. degree. After further practical experience in the mining industry, he joined the staff of the *Colliery Guardian* in 1931, was appointed editor in 1944, a director of the company in 1948, and assistant managing director in 1949.

* * *

Mr. E. Humphrey Browne, C.B.E., deputy chairman of the National Coal Board, has been appointed a director of the National Industrial Fuel Efficiency Service.

* * *

The Switchgear Division of **Associated Electrical Industries Ltd.** has received an order from the Central Electricity Generating Board for a new switching station at Brinsworth, near Sheffield, which will provide for the new steelworks projects in the area. The order includes seven 275-kV lenticular tank oil circuit-breakers, 20 isolating switches, six earthing switches, control and relay panels, and connection materials for the outdoor equipment. The main items will be manufactured at the Switchgear Division's Willesden and Higher Openshaw works, and the installation is to be commissioned during the second quarter of 1962.

* * *

Ivor Power Specialty Co. Ltd., which is owned by **Aberdare Engineering Limited,** one of the Aberdare Holdings Ltd. Group of Companies, announce that as from November 1st, 1960, the trading activities of the company will be carried on in the name of **Aberdare Engineering Limited.** Contracts entered into prior to this date will be fulfilled by Aberdare Engineering Limited, to whom all orders, correspondence, enquiries and invoices should now be addressed. This change is of a purely domestic nature, and has been adopted in order to facilitate the work of the company's secretarial and accounting departments.

* * *

Ambuco Limited (a subsidiary of Buell Engineering Company, Inc., New York), Standbrook House, 2/5, Old Bond Street, London, W.1, recently issued a brochure entitled "Ambuco Cyclones." The brochure describes the company's range of high-efficiency mechanical dust-collectors, and includes details of sizes and general dimensions.

The centre piece of the stand of **Albright & Wilson (Mfg.) Limited,** at the Corrosion Exhibition, to be held at Olympia (November 29th-December 2nd) will be a working model of a condenser cell, loaned by courtesy of the director of the National Engineering Laboratory (D.S.I.R.). This model will be used to demonstrate the ability of *Hagafilm* to promote dropwise condensation of steam. *Hagafilm* is a filming amine used to prevent corrosion and improve heat transfer in process heaters, space heaters, evaporators and condensate lines. Other water-treatment chemicals on the Albright & Wilson stand will be *Calgon* and *Micromet*, for threshold treatment in water heating and cooling systems, and *Calgon Descaler*, used in cooling towers, small boilers and heat-exchangers, which contains inhibitors to protect almost all metals and a colour indicator showing when the solution is exhausted. Also on the Albright and Wilson stand will be featured *Kanigen*, a chemically-deposited nickel plate which is exceptionally hard and corrosion resistant, and can be plated on to almost all metals, as well as plastics and ceramics. For an extremely ductile deposit, the uses of Plusbrite nickel plating solutions, giving a semi-bright or fully-bright finish, will be exhibited. *Standard Plusbrite* is a fully bright finish; SBSF gives a semi-bright finish with exceptional corrosion resistance, and *Plusbrite Duplex* is a fully bright finish on a semi-bright layer for maximum levelling plus excellent corrosion resistance.

* * *

The General Electric Co. Ltd. has received an order valued at over £176,000 for six 2,150 h.p. booster pump motors and four 4,750 h.p. standby variable-speed boiler feed-pump motors with liquid controllers for Blyth "B" generating station of the Central Electricity Generating Board. The equipment is being made to the order of Hathorn, Davey & Co. Ltd., who are building the pumps which are, of course, of Sulzer design. With this order the total value of boiler feed-pump motors, booster pump motors and ancillary gear in hand by the G.E.C. for power stations in the U.K. is over £820,000. These include 20 motors totalling 58,400 h.p. for Blyth "B," 14 motors totalling 54,100 h.p. for West Thurrock and five motors totalling 26,450 h.p. for Thorpe Marsh generating stations.

* * *

Daniel Adamson and Co. announce that **Mr. S. Shenton,** secretary, and **Mr. G. H. Mutch** have been elected directors. **Dr. A. R. Morcom** has resigned from the board.

On April 1st, 1961, as part of the Group reorganisation, the Crucible Department will become a wholly-owned subsidiary company of **The Morgan Crucible Co. Ltd.** It will be known as **Morganite Crucible Limited** and will operate from Norton, near Worcester, where the company have their modern Suprex factory. In preparation for this change, they are now transferring the Crucible Sales Department and some of the technical staff from London to Norton. With effect from Monday, October 5th, 1960, any communication to the company's sales or technical departments at Wandsworth, London, should be made to The Morgan Crucible Co. Ltd., Norton Works, Worcester. Telephone number: Worcester 26691. **Mr. K. R. Mayhook,** who was home sales manager, has been transferred to other duties within the group. **Mr. D. Scott,** who is now in charge of the sales department at Norton, will become, on April 1st, 1961, sales director of Morganite Crucible Limited. The manufacture of Super crucibles at Battersea will continue as before, and adequate stocks of both Super and Suprex will be maintained at both Battersea and Norton.

* * *

Mr. W. A. Attwood, M.A., A.M.I.Mech.E., M.I.H.V.E., has been appointed H.M. Senior Engineering Inspector of Factories, in place of **Mr. H. Eccles,** G.B.E., M.C., A.M.Inst.C.E., who retired on September 30th.

* * *

William Boby & Co. Ltd., water-treatment engineers, Rickmansworth, Herts., are again expanding their design, research and manufacturing capacity. A new laboratory extension doubling the capacity of the existing laboratory is being built adjacent to the present laboratory, and a new assembly shop nearby. All new development is to the rear of the main offices and the drawing offices which were doubled in size earlier in the year. Boby's also have a fully-equipped mobile laboratory for on-site tests. A Dormobile with a special lifting plastic roof has been fitted out with complete laboratory equipment, bench, etc., for field work.

* * *

Flexible Drives (Gilmans) Limited, "Skatoskalo" Works, Millers Road, Warwick, have issued a new publication (60/1) entitled "Skatoskalo." The brochure deals with the extensive range of Skatoskalo machines for boiler scale, tube cleaning, etc., and other equipment, and "Flexmaster" flexible drives and all purposes flexible shaft-driven machines and equipment manufactured by the company.

Latest Power Plant Patents

These extracts from British Patents Specifications are reproduced by permission of The Controller of H.M. Stationery Office. (Complete British Specifications can be obtained from the Patent Office, 26, Southampton Buildings, London, W.C.2. Price 3s. 6d. each, both inland and abroad.)

Steam generator with liquid metal as heat carrier

This invention relates to steam-generating plant and to a method of generating steam. In particular, the invention relates to the generation of steam by means of heat carried by a liquid metal comprising sodium, potassium or an alloy of these metals. The use of this metal as a heat transfer medium in nuclear power plant is particularly attractive because of its relatively low neutron capture cross-section. Moreover, it possesses other desirable physical properties, namely, a low vapour pressure, a high boiling point, a low viscosity, a high thermal conductivity, a high specific heat and a low density. There are, however, considerable operational hazards connected with such use, one of the most dangerous being that due to chemical reaction between the sodium and/or potassium and water resulting in the generation at high-pressure of hydrogen which is liable to combine with oxygen to cause a violent explosion. The invention is based on the appreciation that if steam, rather than water, comes into direct contact with sodium or potassium, the risk of an explosive reaction is much reduced. This is particularly the case if the steam is superheated. In normal operation of the unit shown in outline in Fig. 1, heat is generated in the nuclear reactor (1) and the liquid metal coolant, which is circulated under the influence of pumping means by way of return duct (3) and outlet duct (2) is heated in the reactor (1), the heated liquid metal passing from the reactor by way of outlet duct (2) to the inlets of the superheater heating coils (5, 5A, 5B and 5C) and to the inlet of the reheater heating coil (18) when a reheater is provided. The heated liquid metal flows from the outlet duct (2) through the heating coils in parallel, and in the heating coils (5, 5A, 5B and 5C, and 18) the liquid metal is cooled, giving up part of its heat to superheated steam flowing through the heating spaces of the associated heat-exchangers. Cooled liquid metal is returned from the outlets of the heating coils by way of return duct (3) to the reactor (1). Feedwater is supplied at substantial pressure to the shells of the evaporator heat-exchangers (9, 9A and 9B) which are arranged in parallel as regards feedwater flow. Under the influence of heat from superheated steam flowing through the respective heating coils of the evaporator, the feedwater is evaporated and steam is discharged from the heat-exchangers (9, 9A and 9B) by way of respective steam outlets (12, 12A and 12B) to the common line (13). The common line (13) supplies the slightly-superheated steam to the shell (6) of the superheater heat-exchanger (4) within which, the slightly superheated steam is substantially superheated under the influence of heat from the liquid metal flowing through the heating coil (5) of the heat-exchanger (4). After this substantial superheating the steam is passed by way of the pipe part (7A) to the inlet of the heating coil (8) of the evaporator heat-exchanger (9), and as the steam passes through the heating coil (8) it gives up heat for the generation of steam from the feedwater in the evaporator shell (10). In its passage through the heating coil (8) the steam is cooled, suitably to a slightly superheated condition, i.e., to a temperature above the saturation temperature, before passing by way of pipe part (7B) to the shell of the superheater heat-exchanger (4A). In the latter the slightly superheated steam from the heating coil (8) is again superheated to a substantial degree under the influence of heat from the liquid metal flowing through the heating coil (5A), and the superheated steam is then passed to the second evaporator (9A) where it is cooled by the generation of steam in the shell of the evaporator in the manner described in connection with the evaporator (9). After the evaporator (9A), the steam passes through the shell (6B) of superheater heat-exchanger (4B), thence through the heating coil (8B) of the evaporator (9B) and finally through the shell (6C) of the superheater heat-exchanger (4C) to be discharged as steam superheated to a substantial degree through the outlet line (16) to the point of consumption. The superheater heat-exchangers (4B and 4C) act in the manner already described in connection with the heat-exchangers (4 and 4A), and the evaporator heat-exchanger (9B) acts in the manner described in connection with the evaporator heat-exchangers (9 and 9A), the steam leaving the evaporator heat-exchangers at temperatures above the saturation temperature, and leaving the superheater heat-exchangers with a substantial degree of superheat. The steam already possessing a degree of superheat is finally superheated before passing to the turbine by indirect heat-exchange with liquid metal in the heat-exchanger (4C). When the reheat means (17) is provided, the steam while possessing a degree of superheat is reheated between pressure stages of the turbine. To this end steam at a temperature above its saturation temperature is supplied from the outlet of one stage of the turbine to the inlet (20) of the shell (19) of reheater (17) and the steam is heated under the influence of liquid metal passing through the heating coil (18) before being discharged through the outlet at a temperature substantially above the saturation temperature for expansion in the

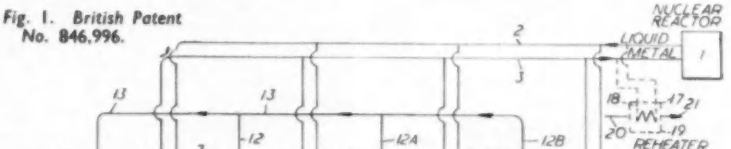
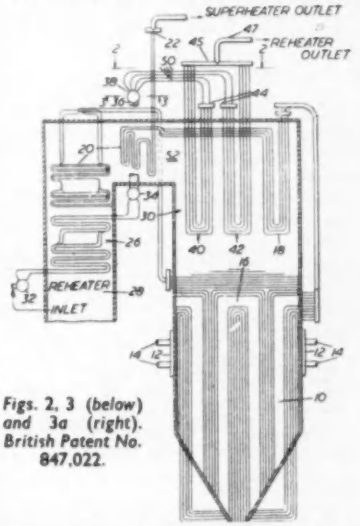


Fig. 1. British Patent No. 846,996.

next stage of the turbine. In one particular application of the invention, a unit in accordance with Fig. 1, discharges steam for use from the outlet line (16) at a pressure of 2,000 lb./sq. in., and the feedwater is supplied to the evaporator heat-exchangers (9, 9A and 9B) at a temperature of 450 deg. F. Superheated steam is supplied from the evaporator heat-exchangers (9, 9A and 9B) at a temperature of approximately 680 deg. F. to the common steam line (13) for supply to the superheater heat-exchanger (4). In passing through the shell (6) of the heat-exchanger (4), the steam is further superheated from 680 deg. F. to 1,000 deg. F. before passing to the evaporator heating coil (8) of the heat-exchanger (9). In passing through the heating coil (8), the steam is cooled from 1,000 deg. F. to 680 deg. F. before supply to the heat-exchanger (4A) for further superheating. Each superheater heat-exchanger operates to supply superheated steam at 1,000 deg. F., and each evaporator heat-exchanger to discharge steam to the following superheater heat-exchanger at 680 deg. F. *British Patent No.* 846,996 *issued to Babcock & Wilcox Limited. Complete specification published September* 7th, 1960.

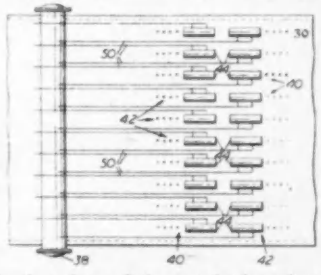
Steam generator for supercritical pressure

In order to prevent overheating of any of the tubes of a radiant reheater, of a boiler operating at supercritical pressures, the invention envisages means for proportioning the steam flow through the parallel connected panels of the reheater so that those located in zones where the mass flow or temperature of the gases is higher than in other zones will receive a sufficiently greater proportion of the steam flow. Referring to Figs. 2 and 3, the steam generator comprises a furnace (10) which is tangentially fired through burners (12) at the four corners of the furnace. Steam at supercritical-pressure and high-temperature is generated by means of the radiant heating surface (16) lining the furnace walls, the platen surface (18) and the convection surface (20). These surfaces deliver steam to the outlet header (22), which is connected through pipe (24) to the turbine at, for example, 5,000 lb./sq. in. and 1,150 deg. F. The steam reheater comprises a convection section (26) and a radiant section (30) in the upper end of the furnace. The steam from the convection section is led into drum (28). The radiant reheater section (30) is composed of several rows of tubular panels or platens spaced across the width of the furnace as shown in Fig. 3, each row having two platens (40 and 42) in parallel-flow relation extending across the depth of the furnace. Each platen is supplied with steam from a separate inlet header (44), and discharges into the outlet header (45) from which the reheated steam is led through pipe (47) to the turbine. Each of the inlet headers (44) is interconnected with the distribution drum (38) through a pair of supply tubes (50). Thus, by controlling the steam flow through supply tubes (50), or the steam-flow entering the supply tubes, the steam flow through each of the platens may be controlled.

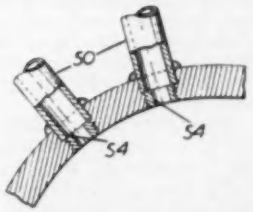


Figs. 2, 3 (below) and 3a (right). British Patent No. 847,022.

Experience has shown that the distribution of heat across a furnace is non-uniform, there often being a substantial variation both across the width of the furnace as well as from front to back of the furnace. This non-uniformity is evidenced in all firing methods including tangential firing. Therefore, depending upon



the location of the particular platen, the rate of heat absorption of some of the platens will be substantially greater than that of other platens, and if no corrective measures were taken, the tube metal temperature of the platens receiving the higher heat absorption may be raised sufficiently to cause the tubes to rupture, with the low inside film coefficient prevailing in reheaters being a substantial factor in contributing to this situation. In order to offset the effect of the uneven distribution of heat across the furnace upon the metal temperature of the various reheater platens, the total steam-flow through the platens is proportioned in such a manner that the temperature of the steam issuing from each platen is generally the same. This proportioning of the flow is accomplished by providing flow restrictor orifices, such as (54) Fig. 3a, at the inlets of the supply tubes (50) to the platens which are located in zones of relatively low heat absorption. The supply tubes to the platens in the zones of highest heat absorption are left free of such restrictor orifices, and the size of the orifices may be chosen so that the temperature of the steam leaving each platen is generally uniform. Although a rough prediction may be made so that orifices may be initially installed to correct the effect of uneven distribution of heat across the furnace, the final arrangement and selection



of orifices would be determined by the actual measurement of the temperature of the steam issuing from each platen in operation of the steam generator, and then shutting down the unit and installing the orifices so as to give a generally uniform steam temperature. The orifice (54) may be of any construction desired, with those shown being threaded into a suitable bore provided in the drum at the inner end of tubes (50) and then tack welded in place. *British Patent No.* 847,022 *issued to Combustion Engineering Inc. Complete specification published September 7th,* 1960.

Removing deposits from oil fired furnaces

This invention relates to the operation of oil fired furnaces, e.g. boilers which use a sulphur containing oil fuel, and particularly relates to a method whereby the corrosion effects of deposits, produced by condensation of flue gas in low temperature parts of the furnace installation, may be minimised. In Fig. 4 a sulphur-

containing fuel-oil enters line (1) into a combustion chamber (2) containing a bank of water tubes, through which water circulates and absorbs heat from the products of combustion. The hot flue-gases leave the combustion chamber at (4) at a temperature of approximately 1,100 deg. F., and enter the superheater (5). The flue-gases are passed to an economiser (8) at about 400 deg. F., and are then led into the air-heater (11). The spent flue-gases are led to the chimney (15) at approximately 300 deg. F. During the passage of the flue-gases through the air-heater, condensation occurs, resulting in the deposition of acid products on the outside of the air-heater tubes (12). During normal operation these tubes are at a temperature of about 180 to 210 deg. F., and at this temperature the deposits contain considerable quantities of free sulphuric acid. In normal operation, the furnace is periodically shut-down, and the acid products are washed out with water. It has been found that the dilution of the strong acids present on the air-heater tubes results in a very strong corrosion of the metal tubes, and furthermore, the acid products are not completely removed except by prolonged washing. The invention is based on an observation of the behaviour of metal surfaces over which moist SO_3 containing flue-gas is passed. Thus, in an experiment, a steel block was inserted in a stream of flue-gas at different temperatures, and the corrosion effects determined by weighing. The net gain in weight after prolonged exposure to the gases was compounded of an actual metal weight loss due to disappearance of the steel owing to corrosion, and a weight gain due to the weight of the corrosion deposits. The ratio of the net weight gain to weight loss against temperature of exposure was as follows:

Flue gas temperature (deg. F.)	*Ratio new weight gain/ weight loss*
180	66
200	35
225	12
250	2.1
275	2.2
300	2.6

It will be observed that there is a sharp drop in the ratio between a temperature of 225 and 250 deg. F. It was found that the high ratios obtained at temperatures below 250 deg. F. are due to deposit lay-down of corrosion products and excess acid, i.e. acid remaining on the surface and not exerting a corrosive effect. The low ratios obtained at temperature above 250 deg. F., however, are due to the absence of excess acid on the metal surface, i.e. all the deposits were corrosion products, and not products plus acid. The invention comprises a method of removing the deposits on surfaces resulting from condensation effects

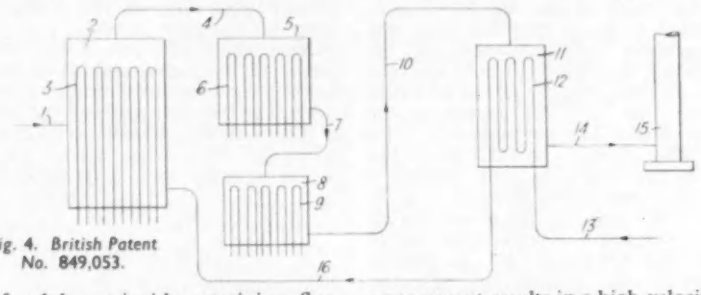
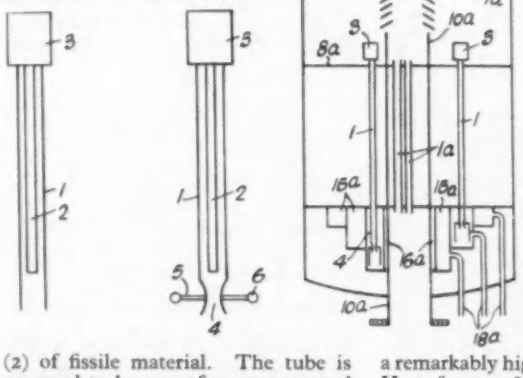


Fig. 4. British Patent No. 849,053.

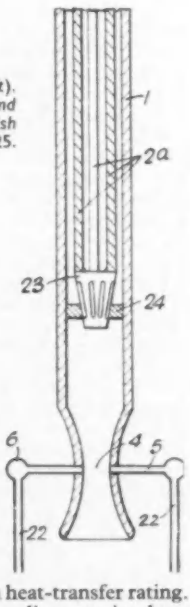
of sulphur trioxide-containing flue-gases, comprising heating the deposit laden surfaces to a temperature above 250 deg. F., for a sufficient period of time for the deposits to become dry, and then water-washing the deposits whereby they are substantially removed. Using this method of deposit removal it is clear that contacting the deposits at temperature above 250 deg. F. means that there is no acid present to be diluted, and therefore corrosion is not aggravated by dilution of acid. *British Patent No.* 849,053 *issued to Esso Research and Engineering Company. Complete specification published September 21st,* 1960.

Nuclear reactor

An object of this invention is to provide an improved nuclear reactor employing a coolant preferably in the form of a liquid suspended in its own saturated vapour. In the vertically-arranged tube (1) showing in outline in Fig. 5, is contained a rod element



Figs. 5 & 6 (below left). Fig. 7 (below) and Fig. 8 (right). British Patent No. 849,225.



(2) of fissile material. The tube is assumed to be one of many arranged in parallel relationship such that the fuel elements (2) congregate to form a nuclear chain reacting mass. The tube is adapted to entrain particles of liquid in a stream of its vapour by feeding the liquid to the lower-end of the tube at a predetermined rate, and by selecting a tube and fuel element diameter in relation to the heat-rating of the rod so that boiling occurs within a very short distance at the bottom of the tube. The arrangement results in a high-velocity stream of "wet" vapour. At the top of the tube (1) is a vapour liquid separator (3) of any suitable known type. Referring to Fig. 6, tube (1), fuel element (2) and separator (3) are similar to Fig. 5, but the tube is adapted to entrain particles of liquid into a gas-stream fed to the bottom of the tube independent of the liquid. The adaptation consists in the provision of a venturi throat (4) with radial liquid feed tubes (5) connected to a supply manifold (6). The structure of Fig. 6 has been found to have a remarkably high heat-transfer rating. Heat from a $\frac{3}{4}$ in. diam. 29 in. long smooth-surfaced element (2) contained in a tube (1) of $\frac{1}{2}$ in. internal diam. can be released at rates exceeding 10 kW by injecting water

into dry steam supplied to the bottom of the tube at a pressure of 30 lb./sq. in., giving a mean pressure of 22.5 lb./sq. in. Thus, high rates of heat-transfer can be obtained in a system which is virtually non-pressurised, and still higher rates are obtainable under the higher pressures required for power generation. The structure shown in Fig. 6 may be embodied in a reactor in the manner shown in Figs. 7 and 8. In Fig. 7 a pressure-shell (7a) contains a calandria (8a), above which the shell is divided into inner and outer zones (9a and 12a). The superheating tubes (1a) are arranged centrally in the calandria (8a), and the steam generating tubes (1), provided with venturis (4), are arranged in an outer annular zone of the calandria. A header (15a) is provided for each circle of tubes (1), i.e. each set of tubes on a common radius, and the headers (15a) are stepped downwards towards the centre to give access to the inner headers. Fig. 8 shows the lower part of a tube (1) in greater detail. The ring manifold (6) is seen to be provided with dip tubes (22) and the fuel-element takes the form of a cluster of rods (2a) connected to an apertured hollow cone (23) which rests in a conical seat (24). A tangential feed pipe (18a), Fig. 7, is provided to each header (15a), and the cylindrical partition (10a) is extended below the calandria (8a) to constitute a superheated steam outlet. A gas-space (16a) serves to insulate the inner header (15a) from the superheated steam leaving the cylindrical partition (10a). Stand pipes (not shown) are provided to return water which collects in zone (12) below the separator to the respective header (15a). In operation, a mixture of steam and water is fed to each header (15a). The water is separated due to the tangential feed, and collects in the bottom of the headers and is then drawn up the dip tubes (22) by venturi action and entrained in the steam in its passage through each tube (1). Water leaving the tops of the tubes is separated and returned to the headers. Meanwhile, saturated steam passes through the louvres (11) into the inner zone (9a) down through the superheater tubes (1a) and is discharged centrally at the bottom of the reactor. *British Patent No. 849,225 issued to United Kingdom Atomic Energy Authority. Complete specification published September 21st, 1960.*

Steam turbine-pump unit

It is common practice at the present time to use a large and expensive bearing whenever a large thrust load must be overcome in starting a turbine-driven pump unit. This practice, however, creates waste, because in subsequent operation, a hydrodynamic oil film will be developed by rotation under the bearing pads or bearing surfaces, and the load-carrying capacity of the bearing increased to a greater extent than is needed, whereby the bearing is more expensive than one that could effectively handle the normal thrust load requirements of the unit. Accordingly, in order to eliminate this waste, it is part of this invention to provide the pumping unit with suitable means to counterbalance the starting thrust load, thereby permitting the thrust bearing to be selected independently of this factor, and thus in accordance with its expected normal operational thrust load requirements. In Fig. 9, a partly broken away longitudinal section of the steam turbine-driven pump unit is shown which embodies the invention. The pump designated (1) and the steam turbine (2) are shown suitably mounted on a common shaft (3), so that the turbine wheel (4) when driven by the steam will in turn drive the pump impeller (5). The fluid to be pumped enters the pump (1) through its inlet (6), and prior to starting of the pumping unit this fluid contained in the inlet (6) will cause a thrust load on the shaft (3) in the direction of the arrow (*A*). More specifically, this thrust load at starting is due to the static pressure of the fluid, which pressure may be about 200 lb./sq. in. and cause a thrust load of between 20,000 and 30,000 lb. on the shaft (3). Situated to the right of the turbine (2), as shown in the drawing, and suitably mounted about the shaft (3) to provide support to this shaft against thrust, is a suitable type thrust-bearing (7) of the Kingsbury type. This bearing is no larger in size or more expensive than is needed for normal operational thrust load. Prior to starting of the pumping unit, high-pressure steam is admitted through the inlet (26) to the steam chamber (22), and in this chamber the steam exerts a force against the turbine wheel (4) in the direction of the arrow (*B*). This force exerted by the steam against the turbine wheel (4) counterbalances the starting axial load caused by the static pressure of the fluid within the pump inlet (6) and thus accomplishes the object of the invention. *British Patent No. 849,358 issued to Worthington Corporation. Complete specification published September 28th, 1960.*

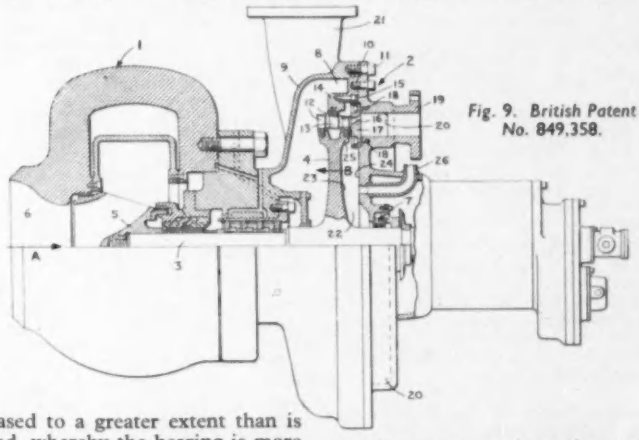


Fig. 9. British Patent No. 849,358.

International Combustion Products Limited, recently issued two new publications (G.604 and G.6014) and entitled respectively "The Dynocone solid bowl continuous centrifuge," and "Rod Decks for Ty-rock vibrating screens." The Dynocone solid bowl continuous centrifuge is a machine of British design and manufacture for the separation of solids from liquid suspensions and for hydraulic classification. Operating on the principles of separation embodied in the original patents taken out in America by W. E. Laughlin, the Dynocone has an entirely new drive and controls which ensure continuous and trouble-free service. This new drive is patented in the United Kingdom and principal countries throughout the world. The Dynocone is designed to handle a wide range of materials including aluminium hydrate, barium sulphate, china clay, chromium oxides, fine coal, iron oxide, sodium sulphate, etc., etc. Sizes of machines available range from a 100 g.p.h. (liquid) and 400 lb./hr. (solids) to the largest, which has a capacity of 25 tons/hr. The Ty-rock screen is the latest addition to the company's wide range of screens, and is designed to effect separation of coarse material from the more viscous substances and slurries. The machine is ruggedly constructed, and the sound engineering principles on which the design is based, reduce maintenance requirements to minimum, the replacement parts being readily accessible.

NOTES *Personal* AND *Industrial*

The Minister of Power has reappointed **Lord Citrine,** G.B.E., LL.D., Companion I.E.E., as a part-time member of the Electricity Council.

* * *

Messrs. Merz & McLellan announce that they are taking into partnership **Mr. T. W. Wilcox,** who has been a member of their staff for a number of years. Mr. Wilcox will normally be at their Newcastle office.

* * *

The following appointments have been made in the sales organisation of the Brightside Foundry and Engineering Co. Ltd., Ecclesfield, Sheffield : **Mr. G. E. Robinson**—general sales manager **Mr. G. H. Lewis**—sales manager, (Foundry Division) and **Mr. T. Hessey**—technical sales manager.

* * *

George Angus & Co. Ltd., Angus House, Westgate Road, Newcastle upon Tyne, 1, have issued a new 38-page catalogue (reference No. 340/2/60HK) which gives detailed information and useful guidance on the correct selection of packings and jointings for individual requirements.

* * *

Mr. C. E. Wrangham, deputy chairman of Davy-Ashmore Limited, has joined the board of Simon-Carves Limited.

* * *

Hamworthy Engineering Limited, Poole, Dorset, announce that **Mr. R. J. Gates,** at present technical director of the Pool and Ropner Shipping Companies Ltd., is joining them as director and executive assistant to the managing director.

* * *

Mr. W. Hanlon has been appointed a director of Clarke, Chapman & Co. Ltd.

* * *

Mr. E. S. Sellers, M.A. (Cantab.), M.Sc. (Ldn.), M.I.Chem.E., who is head of the B.P. Research Centre, Sunbury-on-Thames, Middlesex, has accepted the invitation to be president of the Junior Institution of Engineers for 1960-61.

* * *

Mr. Oswald Arthur Pallett, for many years supervisor of purchases for the British Thomson-Houston Company, now A.E.I. (Rugby) Limited, has retired after 48 years' service. Mr. Pallett has been acting as a consultant since January of this year, when he was succeeded as supervisor of purchases by **Mr. L. C. J. Carvill.**

* * *

The Consolidated Pneumatic Tool Co. Ltd., Dawes Road, London, S.W.6, announce the appointment of **Mr. Jack Gibson,** B.A., LL.B., as managing director of their South African subsidiary—The Consolidated Pneumatic Tool Co. S.A. (Pty.) Limited, Johannesburg.

Mr. Alfred Ratcliff, M.Inst.C.E., M.I.Mech.E., has been appointed a director of the Metals Division, Imperial Chemical Industries Limited, and a joint managing delegate director of Marston Excelsior Limited, a subsidiary company of I.C.I., with effect from October 1st. At Marston Excelsior, he succeeds **Mr. W. Robson,** M.I.Mech.E., who retired on September 30th.

* * *

Mr. L. M. T. Castle and **Mr. N. C. Macdiarmid,** directors of Stewarts and Lloyds Limited, have joined the board of the Staveley Iron & Chemical Company, which was recently acquired by Stewarts & Lloyds.

* * *

Mr. W. M. H. Stevens, A.M.I.Mech.E., M.S.A.E., has been appointed deputy chairman and joint managing director of Firth Cleveland Pumps Limited, Leicester, a member of the Firth Cleveland Group. Mr. Stevens was formerly the technical director of Bowser International Limited. **Mr. R. W. Hill** continues as joint managing director, and will control sales activities from the Firth Cleveland Group Headquarters, Stornoway House, Cleveland Row, London.

* * *

Lieut-Col. R. B. Lakin has been appointed a director of Vickers-Armstrongs (Engineers) Limited, and general manager of the company's North-East Works, in succession to **Mr. J. R. Kelly,** who has reached normal retirement age.

* * *

Mr. D. R. S. Turner, B.A., A.M.I.Mech.E., has been appointed a director and general manager of Davidson & Co. Ltd., Belfast. Mr. Turner, who received his early engineering training and experience with B.T.H., Rugby, was in charge of the development of the A.E.I. Works at Larne from 1953 to 1958. Since 1958, he has been commercial manager of the Turbine-Generator Division of A.E.I. in Manchester.

* * *

Mr. S. Parker has been appointed home sales manager of J. H. Fenner & Co. Ltd. He joined the company in 1950 as West Midlands representative and was promoted Midlands regional manager in 1954.

* * *

Mr. D. F. Haydon has been appointed general sales manager of Baird & Tatlock (London) Ltd. Mr. Haydon joined the company in 1932, and gained experience in the various commercial departments of the organisation before becoming a technical sales representative in the early part of 1939. In 1952, he became chief technical sales representative, and as such, visited overseas agents and territories, including Portugal, Iraq, Iran, Persian Gulf States, Lebanon, Kuwait, Germany and Holland.

The death occurred on October 3rd, in a Manchester Nursing home, and at the age of 80, of **Lord Simon of Wythenshawe,** who was president of Henry Simon (Holdings) Limited, and of Simon-Carves Limited. Ernest Darwin Simon was the son of Henry Simon, founder of the engineering concern which has developed into the Simon Engineering Group. He was born in Manchester in 1879, was educated at Rugby, and at Pembroke College, Cambridge. He became a member of the Manchester City Council in 1911, and was elected Lord Mayor in 1921, and was Liberal M.P. for the Withington Division of Manchester from 1923-24, and again from 1929-31. During the second world war he was a member of the Advisory Council for Fuel and Power. After the war, he joined the Labour Party and was elevated to the peerage in 1947. From that year, he was, for five years, chairman of the B.B.C.

* * *

The Electricity Council have appointed **Mr. R. D. V. Roberts** as industrial relations adviser to the Council. On the nationalisation of the Electricity Supply Industry in 1948, Mr. Roberts was appointed deputy welfare officer to the British Electricity Authority, but soon after took up the post of secretary to the National Joint Advisory Council of the Electricity Supply Industry—the body set up under the Electricity Act of 1947 to develop joint consultation within the industry. In 1953, he was additionally appointed as deputy director of welfare to the then newly-constituted Central Electricity Authority. On the creation of the Electricity Council in 1958 he was appointed deputy industrial relations adviser, and from that post succeeds Mr. D. G. Dodds.

* * *

Mr. T. H. Thorneycroft, a director of The Harland Engineering Co. Ltd., has been elected to succeed the late **Mr. H. Cowan-Douglas** as chairman of the company.

* * *

Mr. J. F. Parker (chairman), **Mr. G. St.J. Strutt,** C.B.E., and **Mr. E. S. Parker** have retired from the Board of British-Rolling Mills Limited. Mr. J. F. Parker was a founder director of the company, Mr. Strutt served as a director for 40 years and Mr. E. S. Parker has been connected with the company for nearly 50 years. **Mr. R. Ll. Lloyd** has been appointed chairman.

* * *

Charles Winn & Co. Ltd., Granville Street, Birmingham, 1, advise us that their North Western area office has been removed from Stamford Street to 202, Cavendish Street, Ashton-under-Lyne, their telephone number—Ashton 3875, remains the same. **Mr. P. S. Hutton** will continue to be in charge of the company's interests in the area.

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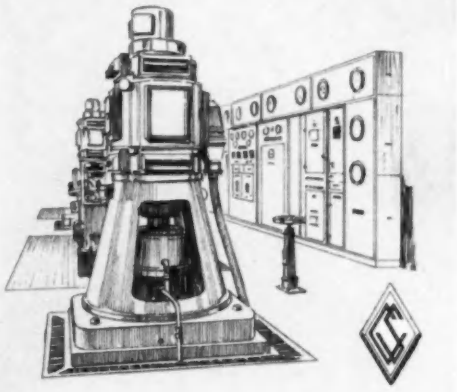

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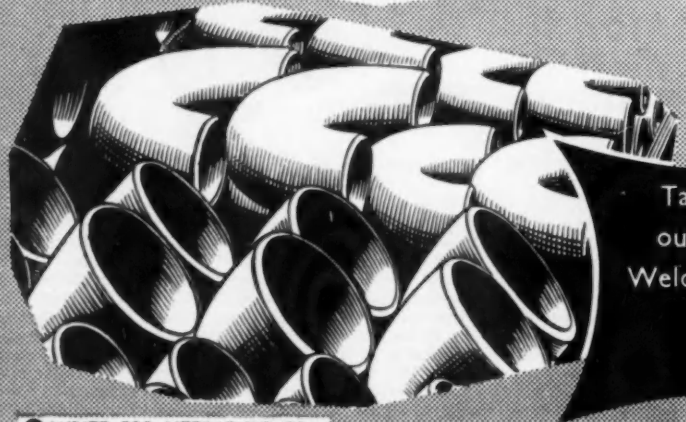

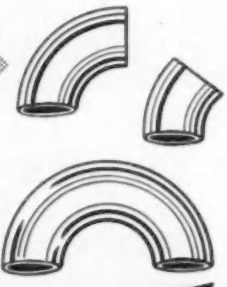

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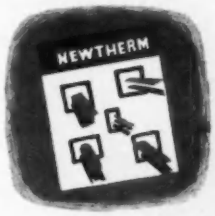

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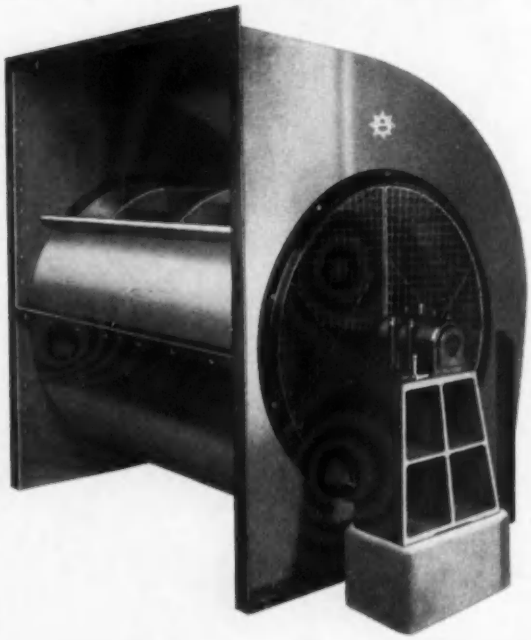

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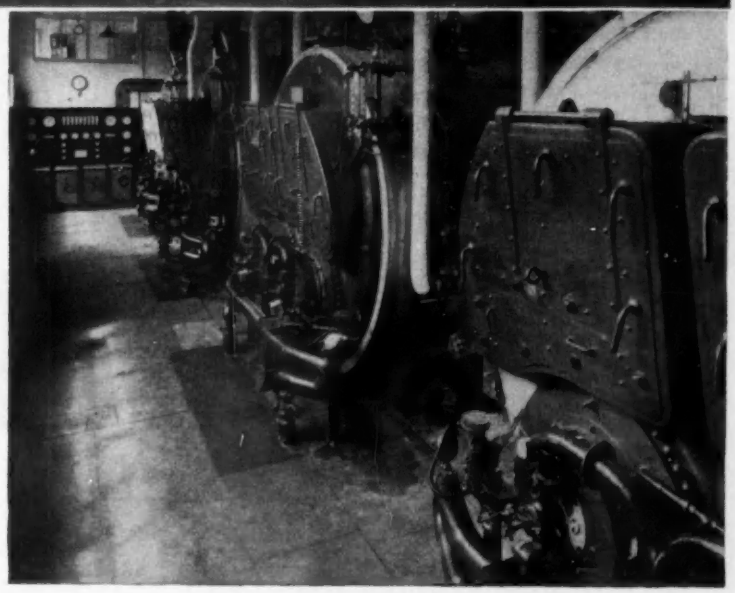
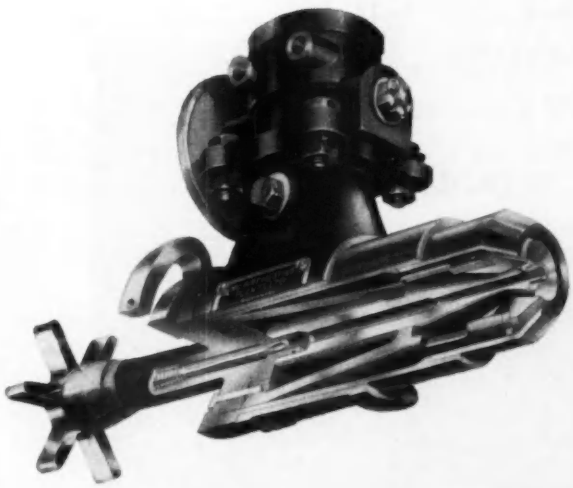


Photos by courtesy of Queen Mary's (Roehampton) Hospital. Boiler plant includes four Marshall Three-pass Economic boilers each fired with two Rotavac No. 3 WSF Burners.



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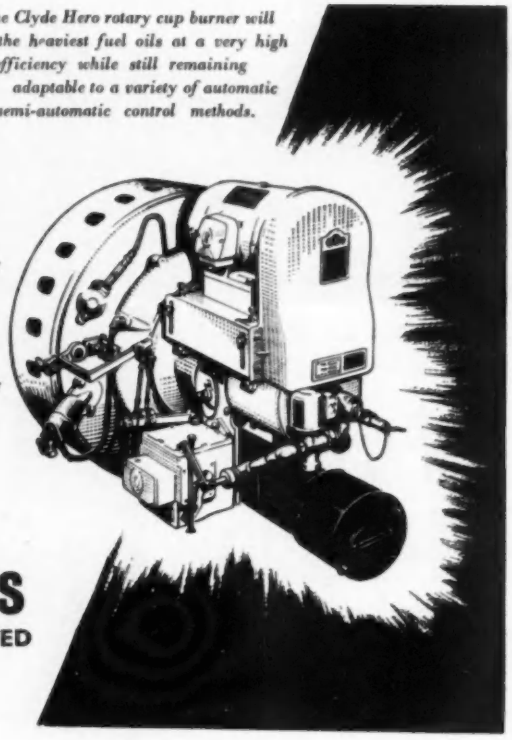

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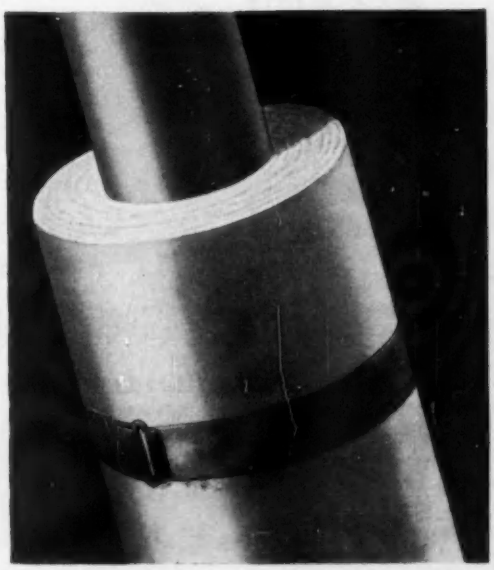

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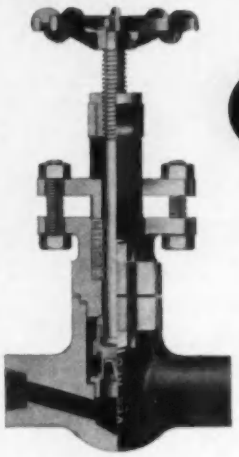

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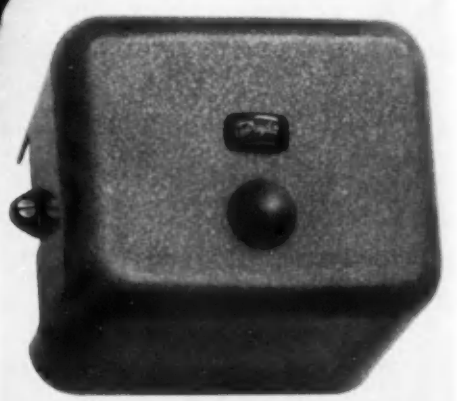

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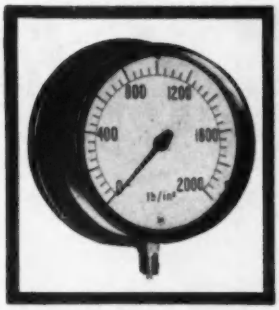

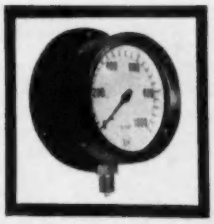

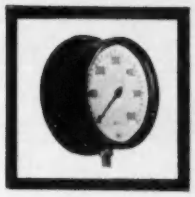

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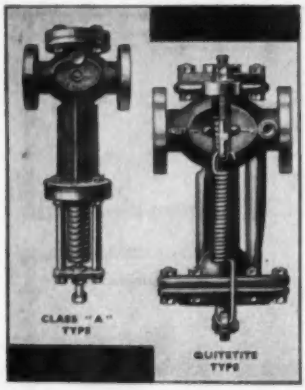

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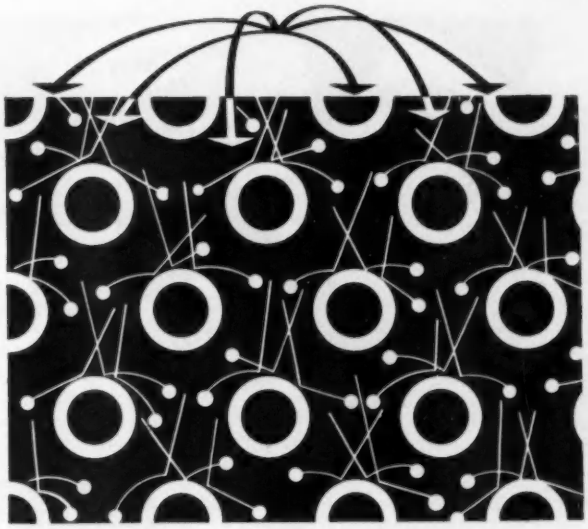

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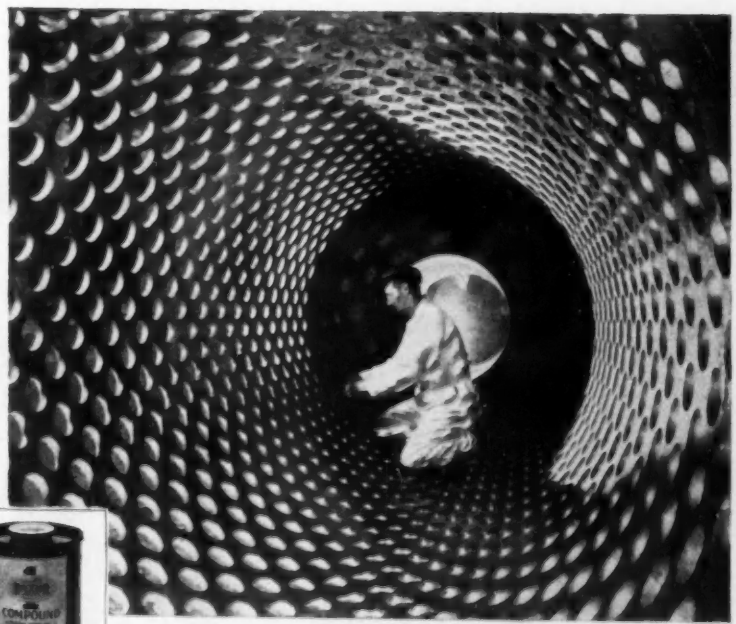

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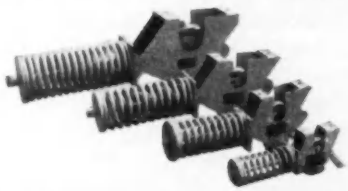

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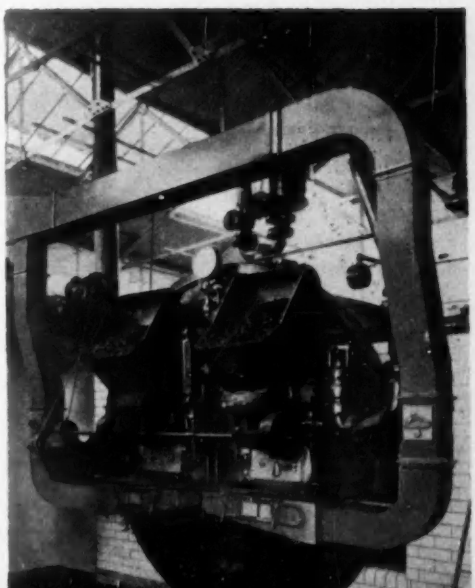

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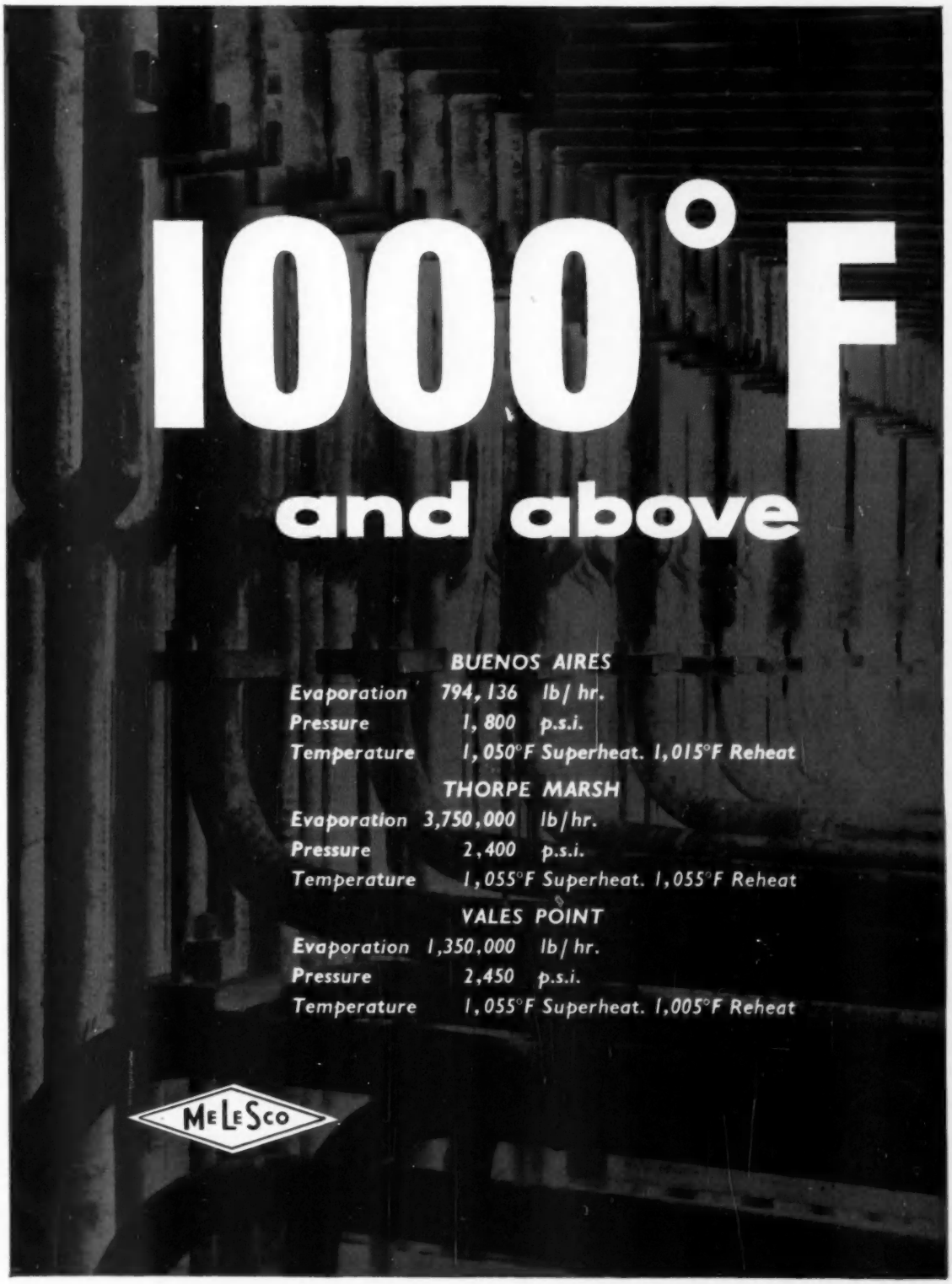

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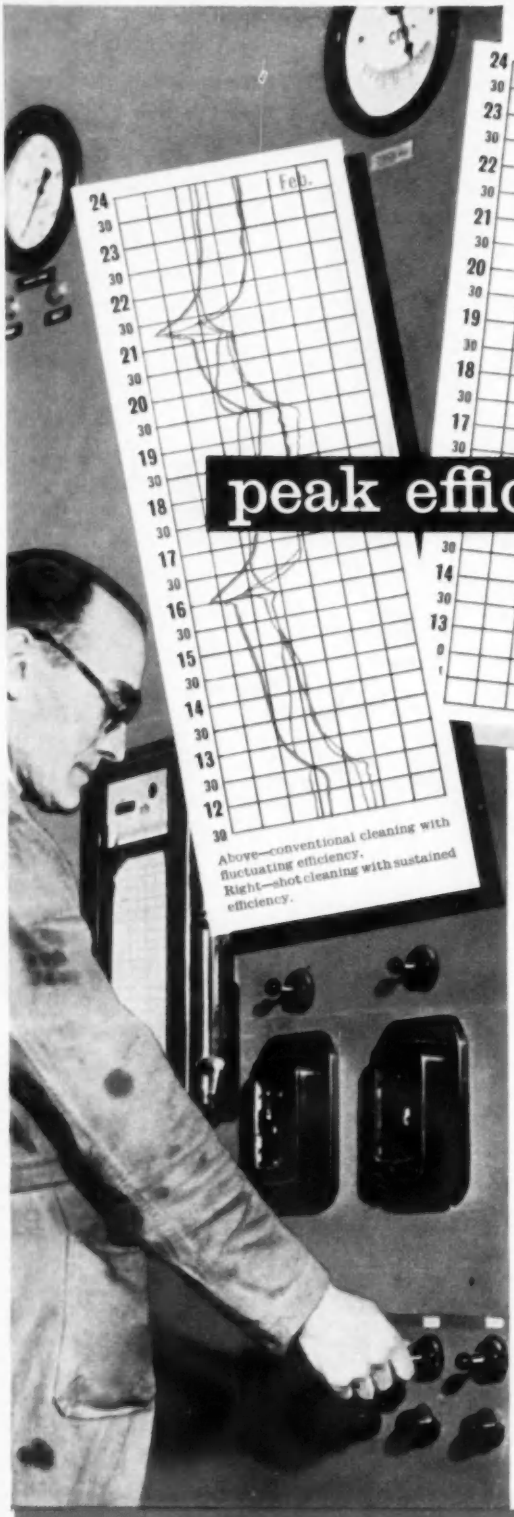

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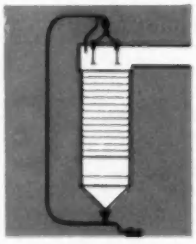

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